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AN ANALYSIS OF ARTICULATE SOUNDS AND ITS USE AND APPLICATION IN THE ART AND SCIENCE OF DENTISTRY

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THE faculty of producing articulate sounds by homo sapiens is an outstanding and luminous landmark in his evolutionary development from the inarticulate fish to the highly integrated, articulate, rational man. Every living organism, from the unicellular to the higher complex, possesses what may be termed mind. This natural phenomenon is predicated upon the idea of essentiality for self preservation and perpetuation of the species. Tropisms are associated with plants; instincts, emotions, and feelings with animals; and the human species, in addition to the latter vital characteristics, is distinguished by thinking and reasoning, and ultimately an ability and will to express ideas and thoughts by means of articulate sounds and language. All human intercourse is transacted through the medium of the written or spoken word. The investigation of the phenomena of sound and speech, and the application to the practice of dentistry of the physical, anatomic, physiologic and psychologic factors associated therewith are the goals of this treatise.

SOUND

"Sound may be considered as a series of vibrations of the air of such frequency, or pitch, that it is audible to the normal human ear." It is produced when air is set into vibration, usually by some vibrating object in contact with the air, and of such frequency of vibration that it is audible. For example, it may be produced by the plucking of a string of a cello or the vibration of the human vocal cords.

Notes of the same pitch, produced by two different kinds of instruments, do not give the same sound impression. This is due to the presence of and differences in overtones, sometimes called harmonics. It is the overtones which give character and brilliance to music as well as quality to the human voice, and

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although the quality of the human voice in singing and speaking is primarily the product of the overtones present, we must remember, as Fletcher has pointed out, that large changes in the intensity and frequency also produce changes in timbre and quality.[1]

SPEECH

Sound waves have certain definite characteristics which determine their loudness, frequency or pitch, and tone.

The sounds of speech are complex, being composed of many simple sounds, each of which has a fundamental frequency (pitch), amplitude (loudness), and tone quality (timbre).

The physical characteristics of frequency, amplitude, and tone of sounds of speech have their subjective counterparts, produced through the audible sensations within the normal human ear.

Physiologic, Psychologic and Anatomic Phases

Speech is an instinctive process. Most defects in it are functional in character and not organic. The first form of "articulate" sound is a vocalization of the reflex type. It is the birth cry of the new born, produced by the expulsion of air from the lungs.

The lungs may be considered the reservoir whose capacity depends on the proper functioning of the diaphragm and intercostal musculature of the thorax. Upon this function, and the autonomic innervation of the respiratory center in the medulla, respiration depends. The respiratory act is divided into two phases, inspiratory and expiratory. While vital capacity is based on the inspiratory phase, voice is dependent primarily on the husbanding of the expiratory current of air. Therefore, it is the frequencies of vibration of the expiratory current of air which ultimately determine the fundamental sounds of speech, to wit: consonants (stops) and vowels (continuants).

The three basic fundamentals of normal speech are: "1. Correct breathing and proper utilization of breath. 2. Correct kinesthetic or muscular imagery, which is designated as the oral position or Oratans. 3. Combination of 1 and 2, to effect a normal output of speech."

"The resultant of these three steps, the production of oral expression, is predicated on the assumption that the individual is possessed of integrated mental processes and is endowed with a normal instinctive urge for speech."[2]

Correct breathing plays a most important role in proper and satisfactory phonation. Of the three types of breathing, chest, waist, and abdominal, chest breathing is preferable and more efficient. However, if the subject's breathing is dominantly abdominal and is regular and sufficient, there is no need of changing the style where speech training is undertaken.

Kinesthesia (Gr. *kinein*, to move, and *aisthesis*, perception) means literally the sense of muscular motion or of muscular force exerted. It also may be defined as that quality of sensation whereby we become aware of our position in space, our movements. When kinesthesia is applied to the speech mechanism it denotes the muscular imagery involved in speech production, which has been

designated the oral position or Oratans. For example, when we see the symbols C-A-T, we not only conjure up in our consciousness the visual image of the feline's size and color, and perhaps the auditory modality, remindful of lunar harmonies of the back alley, but also kinesthetically the symbols, C-A-T, by arching the back part of the tongue against the soft palate for C(k), by raising the front of the tongue slightly for Ă(ae) and pressing the tip of the tongue against the gingivae of the maxillary incisors for T. In doing this, we are using a maximum number of imaginal types, to wit: visual, auditory, and kinesthetic. Obviously one can appreciate the importance of the kinesthetic or vocomotor imagery in speech production. Kimball and Muyskens state that there is no kinesthesis in the tongue; that it depends for control on touch and pressure. (3) The combination of the proper utilization of breath and the correct kinesthetic imagery is the sine qua non for the correct and fruitful functioning of the speech mechanism.

THE ORAL PHONETIC CURVE

1. Genesis.

2. Classification, Definition, and Construction of articulate sounds (groups).

1. The Curve of Articulation (Fig. 1) was the brain child of two speech authorities, Dr. Twitmyer and Dr. Nathanson, of the University of Pennsylvania. They say, "It is 'conceptual' and schematic in one sense, but lends itself to a satisfactory explanation in terms of anatomic correlatives which proved valid statistically as well as theoretically as shown by an analysis of frequency words."[2]

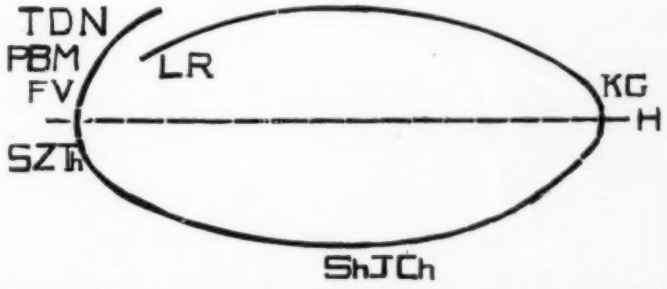

Fig. 1.—Curve of articulation (after Twitmyer and Nathanson).

It was deemed advisable and proper, in order to interpret and give the curve its special and significant dental and oral connotation, that its name be changed to read "The Oral Phonetic Curve" (Fig. 2). We are basically and primarily concerned in the production and modification of the audible frequencies of sounds of the stops (consonants), continuants (vowels), words, phrases, and sentences which have their origin, interruption or modification in the oral cavity and its enveloping musculature. Also, a curve of articulation, interpreted from a dental conception, could denote a curve similar to the curve of Spee, and articulation be associated with articulation of the teeth in the paradontium, occlusion and in artificial dentures. The oral phonetic curve depicts graphically (Fig. 2) the eight major groups of consonants (stops), which by linear graphics have been correlated with the dynamic anatomy associated in their origin, interruption, or modification.

2. Various classifications of sounds of speech have been devised and recorded by speech investigators. With some changes, reservations and modifications in nomenclature, I have chosen the classifications of Twitmyer and Nathanson, Rousseau and Cramer, and McLean for stops (consonants), continuants (vowels), and diphthongs respectively.[2-4] A brief definition of the three main divisions and the method of construction of the articulate sounds in the groups of these divisions will be given. Examples of words, which embody representative articulate sounds, of each member of the respective groups will be furnished. These words, together with countless others, may and should be employed in determining normal and abnormal speech, in individuals with a partial or full complement of teeth, either before or after any dental or oral restoration is made. Although it must not be forgotten that words are, phonetically speaking, a combination of continuant and stop sounds of characteristic, complex frequencies and harmonics, their denotation and connotation attain their most luminous fecundity only in the sanctum of the human mind.

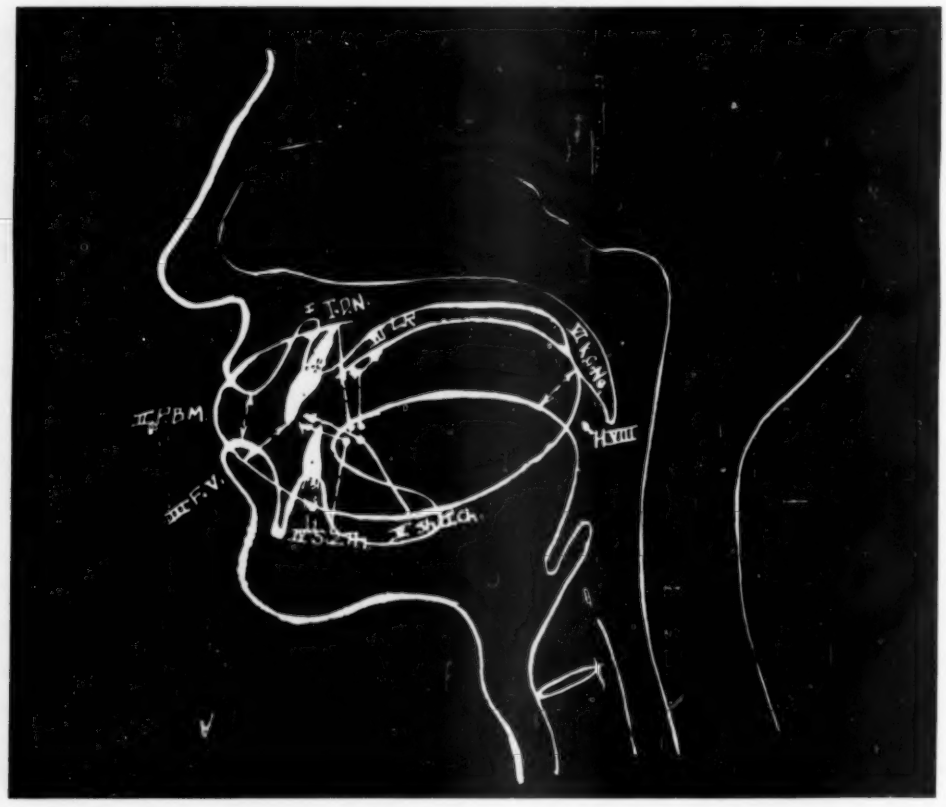

Fig. 2.—The oral phonetic curve.

DIVISIONS OF SOUNDS OF SPEECH

Stops (consonants).—Oral, nasal, vibrated (voiced), breathed (voiceless): Stop sounds are produced by either vibrated or unvibrated breath passing through the larynx, obstructed, interrupted, and modified by tongue, lips, teeth, and palates (Figs. 1, 2, 3*a* and *b*).

Continuants (vowels).—Sounds which are produced by vibrated (voiced) breath passing through the larynx uninterrupted by lips, tongue, or teeth. In the production of these sounds the tip of the tongue plays no part and the soft palate, by contacting and sealing the pharynx, with the aid of the pharyngeal musculature, allows none of the vibrated air to pass into the nasal cavities (Figs. 4*a* and *b*).

CONSONANTAL SOUND GROUPS	LINGUO-DENTALS	BI-LABIALS	LABIO-DENTALS	INTER-POST PALATALS	FRONT PALATALS	BACK PALATALS	LINGUALS	ASPIRATE
Plosive	t-d	p-b				k-g		
Nasal	n	m				ŋ (ng)		
Lateral							L	
Fricative		w-wh (ʍ)	f-v	θ-ð s-z	ʒ-ʃ-ch j		R	H

Fig. 3*a*.—Consonantal Sounds grouped according to location and dynamics.

CONSONANTAL GROUPS	SYMBOL	WORD		PHONETIC SPELLING	
I. Linguo-dentals	T	Tooth	Toot	'tu:θ	'tu:t
	D	Dent	Drop	'dent	'drŏp
	N	Net	Noon	'net	'nu:n
II. Bi-labials	P	Pulp	Pop	'pʌlp	'pŏp
	B	Bone	Beam	'boʊn	'bi:m
	M	Mold	Men	'moʊld	'men
	W	Wear	Way	'wɛ:ə	'weɪ
	Wh	Which	White	'ʍɪtʃ	'ʍaɪt
III. Labio-dentals	F	Food	Fine	'fu:d	'faɪn
	V	Verse	Vocal	'vɜ:s	'voʊkəl
IV. Post-, Inter-dentals	S	Sit	Seal	'sɪt	'si:l
	Z	Zinc	Zone	'zɪnk	'zoʊn
	Th (θ)	Youth	Thin	'ju:θ	'θɪn
	Th (ð)	Thus	Breathe	ðʌs	bri:ð
V. Front-Palatals	Sh (ʃ)	Shade	Shine	'ʃeɪd	'ʃaɪn
	J	Jaw	Rage	'ɜɔ:	'reɪʒ
	Ch	Chew	Chin	'tʃju:	'tʃɪn
	j	New	Yes	'nju:	'jes
VI. Back-Palatals	K	Kite	Kind	'kaɪt	'kaɪnd
	G	Gold	Gland	'goʊld	'gləɪnd
	Ng (ŋ)	Sing	Ring	'sɪŋ	'rɪŋ
VII. Linguals	L	Lip	Light	'lɪp	'laɪt
	R	Root	Room	'ru:t	'ru:m
VIII. Aspirate	H	Heat	Habit	'hi:t	hə'bɪt

Fig. 3*b*.—Words which embody Consonantal Sounds, of Consonantal Groups.

Diphthongs.—A diphthong is a combination, in the same syllable, of two vowel sounds which are so blended in pronunciation that they seem like one sound (Fig. 5).

Consonantal Groups (Figs. 2, 3*a*, 3*b*)

I. Linguo-dentals—T; D (voiced); N (nasal). Construction: Tip of tongue placed against maxillary gingivae of incisors and premaxillary palate.

II. Bi-labials—P; B; M (nasal-voiced); W and WH (ʍ) (fricatives). Lip sounds produced by lip movements. Two other bilabials not directly accounted for on the oral phonetic curve but placed in Fig. 3*a* are W and WH (ʍ). W is classed also as a semi-vowel. The sounds of W and WH(ʍ) are made by rounding the lips and raising the back of the tongue as you would for U in ruby or OO in moon, then quickly separate the lips, making the voiceless sound WH(ʍ) and the voiced W.

III. Labio-dentals—F; V (voiced). Place the lower lip against incisal edges of maxillary incisors.

IV. Post-dentals—S; Z; Interdentals—θ; ð (all fricatives); Z and ð (voiced). S and Z sounds are made by occluding the maxillary and mandibular teeth and exhaling through them. The front of the tongue almost touches the incisal edges of the maxillomandibular incisors, which are nearly closed, the tip being placed a little higher, and the stream of breath is sent in a thin, straight line along the groove in the tongue. Because the breath is compelled to go through a very narrow passage, the voiceless S usually has a hissing quality and the voiced Z a buzzing one. TH (θ) and ð sounds are made by placing the tip of the tongue lightly against the incisal edges of the maxillary incisors and forcing the air out between the tip of the tongue and the maxillo-mandibular incisors.

V. Front-Palatals—SH; J (voiced); CH. Sounds of SH (ʃ) and J (ʒ) are produced by nearly closing the jaws, the front of the tongue widened, and exhaling through the maxillo-mandibular incisors. CH (T plus SH) sound is made by making the sound of T and quickly running into SH. J is a vowel-like consonant and is made by raising the front of the tongue toward the palate as for the vowel i:.

VI. Back-Palatals—K (plosive); G (plosive-voiced); NG (nasal-voiced). K and G sounds are made by pressing the back part of the tongue against the soft palate, quickly lowering it and with the sudden release of air slight explosive sounds are made. In the production of NG the soft palate is lowered and the back part of the tongue arched to meet it, the air being emitted through the nose.

VII. Linguals—L. R (fricative). L is produced by placing the tip of the tongue either against the maxillary incisors, gingivae, or premaxillary area and the breath is expelled over the sides of the tongue. It is the only lateral sound and is voiced. R sound is made by a slight movement of the tip of the tongue upwards and backwards against the roof of the mouth, or by cupping the tongue, keeping the tip free and pointing it toward and very near the palate.

VIII. Aspirate H. H is a pure aspirate, the breath passing through the glottis unvoiced and unmodified by the peripheral organs of speech. It is classi-

fied also as a vowel, but being unvoiced it is not a true one. The tongue takes the position of the vowel that follows it.

In examining closely Figs. 3 and 4, one is immediately struck by the presence of symbols illustrating sounds which are not represented in the familiar English alphabet. Such symbols as C, Q and X are not there, while others such as SH, CH, NG, etc., have been added. Likewise, for the five vowel letters, A, E, I, O, U, there are fifteen phonetic symbols in Figs. 4*a* and *b*, which represent the fifteen sounds intrinsic in the written or spoken word.

Continuants (vowels) (Figs. 4*a* and *b*)

Rousseau and Cramer[4] have classified vowels in five ways: "according to the part of the tongue used, according to the position of the tongue, according to the tension in the tongue, according to the position of the lips in making vowel sounds, and according to whether they are long or short." In Fig. 4*a* the fifteen vowel sounds are represented graphically, the position of the tongue and the areas of the mouth associated in their production, and the part of the tongue used in production. The top line of the keystone represents the roof of the mouth, namely, the premaxillary, maxillary, and soft palate. As one goes from the position necessary for making the high vowels to the low ones, the front of the tongue is gradually lowered and moves posteriorly a little with each drop. This action is graphically represented in the vowel chart Fig. 4*a*.

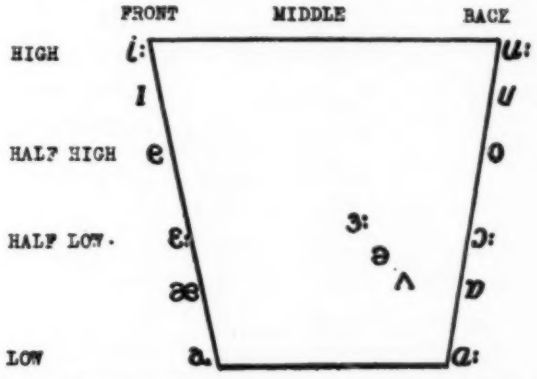

Fig. 4*a*.—Vowel chart (after Tilley, Rousseau, and Kramer) of phonetic symbols, indicating the positions and parts of the tongue and areas of the mouth associated with the production of vowel sounds.

Fig. 4*b* contains representative words, embodying vowel sounds, written phonetically and words whose pronunciation is indicated by a system of diacritical markings.

In the phonetic transcription of words, the stress mark (′) is always placed before the stressed syllable (Fig. 4*b*). The duration of sounds is indicated, particularly in case of vowel sounds, by the length mark (:), which is placed after the symbol, and indicates a vowel of long duration (Fig. 4*b*). For the pronunciation of the vowel sounds of u:, ʊ, o, ɔ:, and ɒ, the lips assume a rounded position and the back of the tongue is lowered from a high to a half low position respectively. In the production of the other vowel sounds the lips are unrounded.[4]

Diphthongs (Fig. 5)

There are nine diphthongs in the English language. They are divided into two groups, the rising and falling. The second vowel sound, in a rising diphthong is made higher in the mouth than the first, while in the falling diphthong it is made lower. There is always an R in words containing the falling diphthongs.[4]

POSITIONS OF MOUTH AND TONGUE	PHONETIC SYMBOL	WORD	PHONETIC SPELLING	WEBSTER'S DIACRITICAL MARK
Front-High	i:	read machine	'ri:d mə'ʃi:n	ē rēd
	ɪ	six city	'sɪks 'sɪtɪ	ĭ sĭks
Half High	e	head men	'hed 'men	ĕ hĕd
Half low	ɛ:	chair fair	'tʃɛ:ə 'fɛ:ə	â châr
	æ	man cat	'mæn 'kæt	ă măn
Low	a	aft ask	'aft 'ask	å åft
Middle or Mixed	ɜ:	girl bird	'gɜ:l 'bɜ:d	ûr gûrl
	ə	baker alone	'beikə a'loun	ẽr bāk'ẽr å ålōne'
	ʌ	upper cut	'ʌpə 'kʌt	ŭ ŭp'ẽr
Back-High	u:	root tool	'ru:t 'tu:l	o͞o͞ ro͞o͞t
	ʊ	book foot	'bʊk 'fʊt	o͝o͝ bo͝o͝k
Half High	o	omit obey	o'mɪt o'beɪ	ŏ ŏmĭt'
Half Low	ɔ:	mortar born	'mɔ:tə 'bɔ:n	ô môr'tẽr
	ɒ	dog cot	'dɒg kɒt	ŏ dŏg
Low	ɑ:	father artist	fa:ðə 'a:tɪst	ä fä'thẽr

Fig. 4*b*.—Words embodying vowel sounds, their phonetic spelling, location of production and diacritical markings (after Rousseau & Cramer).

APPLICATIONS

The application of the phonetic groups of the oral phonetic curve, vowel and diphthong charts for the determination of normal and defective speech in the practice of dentistry.

In the making of speech tests, before and after dental and oral restorations, whether they be in the sphere of prosthesis, oral surgery, or orthodontics, one should employ for this purpose simple words, phrases, or sentences. They should meet the following requirements:

(a) Be suitable for application in the sound groups of the oral phonetic curve, vowel and diphthong charts.

(b) Be of simple construction.

(c) Be suitable and applicable for detecting variations in the individual normal faculty of speech production.

(d) Be of such selection and nature as to invite an intelligent response and reply, the text, if possible, to pertain to the cultural and vocational life of the patient.

The last requirement needs, perhaps, some elaboration and explanation, and must not be taken too literally. According to Dewey's analysis and substantiated by Twitmyer and Nathanson, six words: the, of, and, to, a, and in, comprise 20 per cent of ordinary English.[2] If we add the words, that, it, and is, to the six mentioned, we obtain 25 per cent. Sixty-nine words comprise 50 per cent and one thousand twenty-seven words comprise 78.6 per cent of ordinary English. It is particularly with the higher brackets of words and intellectuality that one's selection and judgment come into play. It must be emphasized that the patient pronounce, unassisted by the dentist, the words or

MOUTH AND TONGUE POSITION	PHONETIC SYMBOL	WORD	PHONETIC SPELLING	WEBSTER'S DIACRITICAL MARK	
Rising-Front	eɪ	fate made	ˈfeɪt ˈmeɪd	ā	fāt
	aɪ	line mind	ˈlaɪn ˈmaind	ī	līn
Back	ou	tone bone	ˈtoun ˈboun	ō	tōn
	ɔɪ	toil joy	ˈtɔɪl ˈdʒɔɪ	oi	toil
	ɑu	ounce sound	ˈɑuns ˈsɑund	ou	ouns
Falling-Front	ɪə	tear near	ˈtɪə ˈnɪə	ēr	tēr
	ɛə	mare rare	ˈmɛə ˈrɛə	âr	mâr
Back	uə	cure mure	ˈkjuə ˈmjuə	ū	kūr
	ɔə	snore tore	ˈsnɔə ˈtɔə	ōr	snōr

Fig. 5.—Diphthong Chart. Words illustrating diphthongs, their phonetic spelling and means of production.

phrases employed in the tests. This may be accomplished by having the patient name or describe relevant objects placed before him, i.e., a tooth, pen, ring, etc., or by directing the patient to read the words in charts similar to those shown in Figs. 3, 4, and 5.

In the use and application of the sound groups on the oral phonetic curve, vowel and diphthong charts, we must obtain not only information relative to the normal and abnormal output of speech, but equally important and necessary, data and information concerning the physiology of the organs and systems of muscles intimately associated with the complex mechanism of phonation. When we consider too, the fact that in spite of the loss of many teeth or the existence of gross malocclusion, many people are capable of effecting a normal speech output, we can appreciate the role played by the neuromuscular compensative factors, and seek the explanation in terms of "human competencies, traits, or trends (residual diatheses)."[2] It is upon these endowments, supplemented at times by speech training, that so many people go through life capable of enunciating clearly and expressively, meeting and resolving in a satisfactory manner their daily social and economic problems. In many cases, however, where the anatomic and functional defects are pronounced as in cleft palates, harelips, congenitally small tongues and soft palates, partial or complete loss of teeth, and defects following surgery for the eradication of malignancy, it is impossible to obtain, except by replacement with artificial substitutes and speech training, the restoration of a voice of good quality and distinct pronunciation.

The motive forces which contribute markedly to the production of speech are exerted through the instrumentality of muscles, and produce a type of muscular function necessary for phonation. These muscles, together with contiguous structures, function not only for and in the acts of mastication, deglutition, facial expression, and respiration, but directly and indirectly take an active part in the highly specialized phenomenon of articulate sound production.

The muscles of mastication, the submental and palatal, the superficial and deep layers of the platysma group, the pharyngeal muscles, and the muscles of the larynx represent the chief groups concerned with phonation, and it should be mentioned, en passant, that the extrinsic muscles of the larynx, particularly those intimately connected with the hyoid bone, play an important part in the mechanism of phonation.

One of the most important pair of ligaments associated with the connections of the cartilages of the larynx is the inferior thyroarytenoids, which consist of bands of fibrous tissue, chiefly elastic, and which support the free edges of the true vocal cords, extending from the angle of the thyroid cartilage a little below the false ones to the vocal processes of the arytenoids.[6] "In the thyroarytenoideus muscle there are six fibers of different origin, different insertions and fasciculi, all of which have fibers of different origin, different insertions, and different actions. There is, therefore, ample arrangement for varying the extent of the vocal cord which is put under tension. This particular muscle is one of the most quickly acting muscles known. The chronaxia is given as one ten-thousandth of a second."[7]

Kimball, and Muyskens have aptly stated that two groups of muscles, the circular or sphincter-like, arranged about the orifice of the mouth, pharynx, and larynx, and the longitudinal, control the necessary size and form of the tube associated with articulate sound production.[3] It must be borne in mind that various characteristic muscular patterns are associated with the production of the diverse sound elements, and that the laryngeal, pharyngeal, trigeminal, facial, and lingual muscular components of each pattern, for each phonetic sound, function synchronously in normal phonation.

Form and structure are the resultants of function. Function implies action and reaction, anabolism and catabolism. Horizontal, vertical torsional, and resultant stresses bring about reciprocal strains in tissues, which ultimately determine the characteristic form and structure of the tissues. In the case of a congenitally large tongue, a muscular macroglossia, it may be observed that the pressure exerted by it in mastication and speech is of sufficient intensity as to force the mandibular and maxillary incisors out of a normal occlusion, with a resultant change of abnormality in the form of the dental alveolar processes and arches. Federspiel reports a case in point, in which not only marked deformity of the jaws and position of the teeth resulted from the macroglossia, but also a marked defect in speech.[8] Many similar reports have been recorded in the literature. The tongue, as a result of the functioning of and through its intrinsic and extrinsic musculature, plays a very large and important role in normal speech production. Greene, however, reports that even where there is an almost complete loss of the tongue, production of such sounds as K and G can still be made by compensations in function of the pharyngeal and adjacent musculatures, and sounds T, D, N, and L can also be produced by the substitution of lip action for tongue.[9]

Where we encounter in individuals a congenital absence of structure in tissues as in cleft palate and harelip, or disharmonies in the relationship of the mandible and maxilla with associated malocclusions, or the loss of a few or all the teeth, we may observe varying degrees of impediment in speech, depending on the size, amount, and location of the defects, the impairment of function, the amount of functional muscular and subcutaneous tissue compensations, the auditory and kinesthetic imageries, the functional efficiency of artificial substitutes, and the "emotion quotient" and so-called "residual diathesis" of the individuals.

One of the most difficult problems and striking challenge to the skill, intelligence, and phonetic pedagogy of the oral surgeon, dentist, and phonetician occurs when they are confronted with the problem of the restoration of individual normal speech in patients having cleft palates. If the cleft involves the hard and soft palates and uvula marked defects in pronunciation occur because of the damage to the structures and function of the tissues and musculature. When the sounds of K, NG and G are made, which normally require the contact of the dorsum of the tongue with the soft palate, or the plosives T, D, P, B, the lateral L, the nasals M and N, the fricatives S, Z, SH, ZH, R, and the vowels, particularly the back ones, there is an escape, or only partial confinement within the oral cavity, of the vibrated, breathed or stopped column of air

into the nasal cavities. The resultant blurred sounds have a characteristic nasal resonance. "The rhinolalia aperta, which results from cleft palate is, phonetically speaking, a blurring of the relatively low pitches characteristic of vowels, especially the so-called back vowels."[10]

Operations for the correction of cleft palate may be considered successful, from the standpoint of phonetics, when the soft palate becomes and remains sufficiently resilient and flexible and of sufficient dimensions that it can, assisted by the pharyngeal musculature, wall off the nasopharynx in order to materially eliminate or attenuate the nasal voice and resonance of cleft subjects. This, however, can only be realized, if at all, by speech training after the operation has been performed, and most cleft palate patients require ear training in order that they may learn and become accustomed to the new and more satisfactory pitches and frequencies of the articulate sounds, as differentiated from the poorer ones made previous to the operation or directly after as a result of habit.

Individuals with cleft palates and harelips generally have teeth missing and displaced and the lateral incisors seem to be invariable victims. The teeth remain after operation in their positions of malocclusion and may interfere with the functioning of an existing weak speech mechanism. It is imperative that orthodontic measures be undertaken in order to restore them, if possible, to more favorable articulatory and phonetic positions. In individuals with harelip the function of the orbicularis oris and its contiguous musculature is impaired and consequently the pronunciation of the bilabial sounds, P, B, M, and W and WH (ʍ), and the back vowels requiring rounded lips, is impaired.

Obdurators are used in the inoperable cases but have limitations in the restoration of function. Mme. Borel-Maisonny has suggested the use of various types of appliances and obdurators for inoperable cases of cleft palate, and other types which have functioned in a satisfactory manner after operation, each of which supplement and assist the soft palate in closing the nasopharynx. She correctly insists that each appliance must meet the specifications for each individual case, and if it fulfills all the requirements necessary for the restoration of function in phonation then but twenty or thirty lessons in speech training is all that is necessary for the restoration of the proper timbre and pitch of the voice.[11] Dorrance has obtained some excellent results, in the reconstruction of the speech mechanism, after the "push-back" operation.

There may be deviations from the normal in the speech output of individuals having malocclusions. Where disharmonies of the maxillomandibular relation occur or palatal vault and tongue incongruencies, when teeth are in malocclusion, congenitally absent or malpositioned; where the premaxillary bone is overdeveloped or underdeveloped resulting in a separation or crowding of the incisor teeth respectively, or otherwise abnormal; where we have partially erupted or crowded teeth, marked overbites, overjets or open bites, and narrow constructed arches or mutilated jaws, we may have a coexistant dysfunction of adjacent structures and an impairment of the function of the musculature associated intrinsically and extrinsically with these structures and organs. There may be an interference, not only with normal muscular function, growth, development, metabolic processes, mastication, deglutition, and respiration but

also an interference with the ability to initiate and pronounce articulate sounds of speech, with the proper quality and flexibility.

In distoclusion (Class II) cases of malocclusion, characterized by a marked protrusion of the maxillary incisors, and marked overbite or overjet, there may be a considerable impairment in the effective speech output, involving particularly the bilabial plosive sounds of P, B, and M, the linguodentals T and D, and the interdental fricatives S and Z. It would be a good procedure in many of these cases, as well as in the mesioclusion (Class III) and open-bite malocclusions, to supplement orthodontic treatment with phonetic exercises, involving the pronunciation of simple words or phrases for the purpose of stimulating and accelerating in a normal direction the function of the impaired muscular systems. For this purpose one may employ the following words: pup, pep, map, mop, beam, tip, tap, sip, sop, dumb; words containing the bilabial fricatives W and WH (ʍ): where, when, which, way; and words containing a combination of sounds which will include the rounded back vowels as moon, book, pop, coop; and phrases such as: "where poppies bloom" and "Bobby mop up" (Figs. 3*b*, 4*b*, 5). By the use of these collateral phonetic exercises we are utilizing the function of the speech mechanism in promoting the restoration of normal function, form, and structure.

In many of the distoclusions, particularly with protruding (labioversion) maxillary incisors and narrow maxillary arches, the consonantal sounds of the linguodentals T and D cannot be pronounced with precision or the proper quality of tone because of the inability of the tongue to make a normal and effective contact with the gingivae and premaxillary mucosae, or because of a leakage posterobuccally, especially if the tongue is functionally inadequate. This condition is observable in many children and adults. Cases have been reported in the literature similar to one of Kimball and Muyskens,[3] and hardly a dentist has escaped the challenge of the restoration of such a malocclusion. Here is where premaxillary alveolectomy might find its greatest usefulness and most fruitful reward, for it will permit, through the use of a partial or full denture, a readjustment and orientation of the articulation which must improve not only masticatory efficiency but also enhance the function of the speech apparatus.

In the mesioclusion (Class III) malocclusions, the bilabial sounds of P, B, and M, the linguodentals T, D, and N, and the interdental sibilants S and Z register deviations from their normal frequency spectra, noted particularly if the lips and the tip of the tongue are restricted in their movements. The labiodental fricatives F and V, may not be properly enunciated and if the malocclusion be aggravated and complicated by the absence of teeth or crowding, a serious interference with the production of one or more of the consonantal sounds may occur.

A case in point is that of a physician, 45 years of age, who had a marked mesioclusion, the mandibular incisors in marked labial occlusion, and in addition a space existed which was formerly occupied by the mandibular left canine. He complained of a speech difficulty but was unable to put his "finger" on it. He was given a chart with words embodying sounds of the consonantal sound

groups (Fig. 3*b*) and had difficulty in pronouncing the TH sound in the word "youth" as well as in other words containing this phonetic sound. He immediately remarked after the diagnosis that he couldn't pronounce properly the word pathologic. As a matter of fact it was only the fricative "TH" which was difficult of pronunciation. This occurred because his tongue could not fully compensate for the space of the lost canine by walling it off sufficiently to allow the column of air to come down and through the median groove in the tongue and out through the intermaxillary incisor opening, while his jaws were slightly separated. Because of this, the TH was muted and indistinct. Curiously enough the tongue was able to make the necessary compensations for the pronunciation of the postdentals S and Z. In the pronunciation of the fricative TH, the tongue tip requires more pointing and "temper" than for the S and Z sounds, and because of this factor full tongue compensation was well-nigh impossible under the circumstances. Likewise, in spite of the malocclusion, all the other sounds were pronounced in a satisfactory manner, as a result, no doubt, of compensations by the functioning muscular, condylar, and articulatory mechanisms.

In marked overbite types of articulation, where the ratio of the overbite to the overjet is 2 to 1 or greater, marked speech abnormalities may exist, especially noticeable in the pronunciation of the sibilant sounds S and Z. This is usually caused by the fact that the column of air escapes laterally because the tongue cannot close or wall off the posterior intermaxillary space when the mandible is in the protrusive position, with a slight intermaxillary opening, the position necessary for the production of these sounds.

In open-bite malocclusions, where the maxillary and mandibular incisors and perhaps premolars make little or no direct contact during the act of mastication or phonation, the pronunciation of some of the consonantal and vowel sounds falls below the accepted standards for these sounds. The interdental fricatives S and Z, TH (θ) and TH (ð) may not be enunciated properly; the front palatals SH, CH, ʒ (dʒ), and perhaps the front high vowel sounds of i and ɪ cannot be pronounced with the characteristic harmonics of the pronunciation of a normal bite relationship. Likewise, there may be an interference with the proper functioning of the orbicularis oris and its contiguous musculature, as a result of which the plosive bilabial sounds of P, B, and M do not attain their normal frequency spectra, their pitch and quality being subnormal.

Sigmatismus or lisping is a common speech defect, involving the sibilant sounds of S and Z. It is generally produced by a misplacement of the tongue, in the presence of a malocclusion, missing teeth or disharmony between tongue and palatal arch. If some of the maxillary or mandibular incisors are missing, either permanently or as a result of delayed eruption as in children, lisping may occur. Greene speaks of an indental form in which the individual says "tshop" for "shop" on account of dental and jaw anomalies such as "cross-bite, interdental spaces, drifting teeth," and an addental form of sigmatismus, in which the individual says "thoap" for "soap," and further comments that a "protruding lower jaw is a source of predisposition, as is also the front open-bite."[9]

The pharyngeal, nasal, and oral cavities, with their characteristic architecture and facades, have a definite influence not only upon the pitch and

amplitude of the sounds of speech, but acting as resonators, exert an important influence on the quality of the voice. The size and shape of the vault of the maxilla, hard and soft palates, the relation of the size and form of the tongue to the vault of the mouth, the size and shape of the oro and nasopharynx, obstructed or unobstructed by lymphatic tonsillar and adenoidal tissue, the freedom from obstructions within the nasal cavities, and the quality and texture of the linings of these resonating cavities have a definite bearing and play an important role in the quality of tone of the voice. It becomes, therefore, exceedingly important for one to know something of the changes in the acoustical properties of these cavities when an artificial or prosthetic appliance is inserted.

An important problem facing the dental profession is the determination of the effect upon the quality, pitch, and amplitude of the voice when appliances made of such diverse materials as gold, platinum, irridium and their combinations, nickel and steel alloys, vulcanite, resins, and other proprietory combinations of metals, are inserted into the mouth in varying shapes and sizes. The problem may be quite complicated in certain cases, as for example, where all teeth have been removed, for in spite of our re-establishment of centric occlusion and maxillo-mandibular functional relationship by the use of the Gysi arch tracing or central bearing point registration and extraoral condylar path registrations, we still must cope with the physiologic and psychologic variables which have a direct bearing on the re-establishment of the functions of mastication and phonation.

A very fruitful experiment on "the effects of a dental prosthetic appliance on the quality of the voice," was conducted by Boghosian and Spangenberg in 1935[13] and their deductions have, indeed, some bearing on our problem.

A skeletal denture was made covering the entire palate in a man having the full complement of teeth and the posterior border of the denture ended in a line connecting the distal surfaces of the second maxillary molars. The denture[14] was made of base plate material which was covered with a layer of wax, the wax reaching approximately to the occlusal surfaces of the molar teeth, being 3 mm. thick over the vault of the palate. The fundamental vocal cord frequency of the subject was approximately 250 cycles per second. A film record of frequencies between 150 and 5000 cycles per second was made and analyzed. Records of six vowel sounds were taken before and after the insertion of the appliance and consisted of the sounds of ā as in tape, ē (team), u (tool), ō (tone), ô (talk), and ä as in father. "All components of each record were plotted to show the relative amplitude distribution of frequency components throughout the range 150 to 5000 cycles per second."[13] A comparison was then made of the plots before and after the appliance was inserted for each sound and the change or shift in the frequencies and amplitudes of the components noted. The results of these experiments indicated that the insertion of the prosthetic appliance "(1) did not cause the amplitude or the frequency of the first major re-enforcement to change markedly, (2) caused a decrease in the amplitudes of other re-enforcements, and (3) caused an increase in the number of frequency components in every vowel studied except that of ā as pronounced in the word tape." It was further concluded that there was a "more

noticeable change caused by the prosthetic appliance in the frequency spectra of the two vowels, ā (tape) and ē (team) than in the other four vowels, which seemed to verify the physiologic observation that in the production of the vowels ā and ē, the mouth is divided into two effective resonating chambers by the tongue; that the volume of the anterior chamber was greatly reduced by the prosthetic appliance, thus causing a diminution of the frequencies resonated by this chamber; that in the production of the vowels, u, ō, ô, and ä, the mouth acts as a single resonating chamber, and that the insertion of the prosthetic appliance caused a smaller percentage of decrease in this resonating chamber than in the case of ā and ē.''[13]

MOUTH POSITION	TONGUE POSITION	LIP POSITION	WORD	WEBSTER SPELLING	PHONETIC SPELLING	PHONETIC SYMBOL	DURATION
Front	High	Unrounded	team	tēm	'ti:m	i:	long
Front	Half High High	Unrounded	tape	tāp	'teɪp	eɪ	short
Back	High	Rounded	tool	tōōl	'tu:l	u:	long
Back	Half High High	Rounded	tone	tōn	'toun	oʊ	short
Back	Half Low	Rounded	talk	tôk	'tɔ:k	ɔ:	long
Back	Low	Unrounded	father	fä'thĕr	'fa:ðə	ɑ	long

Fig. 6.—Analysis of Vowels in Words of Boghosian & Spangenberg Experiment.

In the analysis of the six vowel sounds in Fig. 6, it can be seen that two vowels, namely, ā in tape, and ō in tone, can be further phonetically subdivided, which places them in the category of the diphthongs. The ā in tape is the rising front diphthong eɪ, and the ō in tone the rising back diphthong oʊ. (Figs. 5 and 6). The six vowels are classified with a consideration for the anatomic, physiologic and physical factors associated in their production, and includes the tongue, lip, and mouth positions and the time of duration. The need for and the practicality of this kind of information and analysis become quite obvious after one examines and understands the blueprint of the sound structures. The rationale of this classification and analysis will be more fully understood and appreciated when we come to the consideration, for example, of the use of words for determining intermaxillary bite relationships or the location of the position of the movable soft palate as defined from the hard palate in the postdamming of a full denture, and for the intelligent application of the principles of phonetics to oral restorations and speech defects.

It seems germane to consider some of the conclusions drawn by Boghosian and Spangenberg. The third conclusion will be considered first; namely, ''that the prosthetic appliance caused an increase in the number of frequency components in every vowel studied except that of ā as pronounced in the word tape.'' When one considers that the sound of ā in tape is really a combination of the two sounds of e and ɪ, one is inclined to think of this duality as a contributing factor for the lack of increase of frequency components of the sound

of ā, after the insertion of the prosthetic appliance. The sound e or ɪ bears a close relationship from the standpoint of production to the sound of ē in team, whose frequency spectra does increase after the insertion of the prosthetic appliance. The three sounds, ē, phonetically written as i:, e and ɪ, components of the sound ā, are produced in the front of the mouth; the lip position is unrounded for all three sounds; the tongue position for i: (e) is higher than for e or ɪ, the e being half-high and the ɪ slightly higher, and the time duration of i is "long" when compared to the "short" duration of e and ɪ. Perhaps further investigation, under the same conditions, with regard to the changes in frequency spectra of the sounds of ɪ or e, as pronounced in the words city ('sɪtɪ) and men ('men) respectively, will show some increase in the frequency spectra of both, other than the first major reinforcement, after the insertion of the prosthetic appliance, as it did in the sound of i: (e) in team, and in addition a similar reduction in the amplitudes of other reinforcements after the first major one.

Just what effect the insertion of an appliance of known physical and chemical composition would have upon the frequency spectra of the sounds of the front half-low and low vowels, and the middle half-low and low vowels awaits a future investigation. It may be that the general conclusions of such an investigation will approximate those which Boghosian and Spangenberg obtained for the back-high and back-low vowel sounds. Such experimentation must be conducted with the vowel sounds and not diphthongs.

Five of the six back vowels require rounded lips for their proper production, only a: does not.[4] There was practically no difference in the results of experiments with the back, rounded lip vowels; the rounded, back high u: sound in tool, and the rounded, back half-low ɔ: sound in talk, registering relatively similar results of frequency and amplitude before and after the insertion of the prosthetic appliance.

What the experiments of Boghosian and Spangenberg and others of similar objectives will reveal, by employing a variety of dental materials such as gold plate of known composition and properties, alloys of gold and platinum, steel alloys, vulcanite, resins, etc., await future investigation and will be of inestimable value in the selection of materials for dental restorations. Factors such as changes in the size and volume of the oral cavity after the insertion of a prosthetic appliance, location of bars, position and alignment of teeth, the insertion or absence of ṛugae and the reduction in or modification of the height of the vault of the mouth, all play a role in and have an important bearing on the production of the quality and characteristics of speech.

The determination of the location of palatal and lingual bars or sections is important in partial prosthetic restorations, both from the point of view of mechanics and phonation. Approximately 80 per cent of the consonantal sounds are produced by or through the action of the lips, tip of tongue, maxillary and mandibular incisors, and premaxillary palatal area, and anterior to or slightly posterior to the border of the premaxillary and maxillary palates (Figs. 2, 3*a*). Though all the vowel sounds are produced by the vibration of the expiratory column of air at and by the vocal cords, the tongue and lip positions have

a distinct bearing on their overtone structure (Fig. 6). In the production of over 50 per cent of the vowel sounds, the area of passive functional activity is located in the front and middle sections of the mouth, with varying positions of the tongue from high to low. The experiments of Boghosian and Spangenberg indicate that the greatest change in sound spectra occurred in the "front-mouth and high-tongue" vowel sounds of ē (i:) in team and ā (eɪ) in tape, which would further substantiate the conclusion that where a normal occlusion exists and one has a choice of position for the placement of the palatal bar, that it be made so as to place it posteriorly to the premaxillary area. A palatal bar, placed posteriorly to the premolars, and preferably in a position connecting the distal surfaces of either the first or second molars, would, therefore, cause less change in the quality of the voice.

A restoration with a lingual bar, provided it does not interfere with the mobility of the frenum of the tongue or the free movement of the tip and blade, should offer little or no interference with the functioning of the speech apparatus, in the production of normal phonation. The tactual motor sense of the tongue can operate with impunity, in the presence of the bar, providing the free movement and function of the tongue is not impeded or impaired. Where continuous lingual bars, clasps, or rests are placed on the lingual surfaces of the teeth, they must be so constructed that they do not interfere with the free and facile movement of the tip and blade of the tongue which might interfere with the function of the tactile sense or the exercise of established kinesthetic cues.

Another perplexing phonetic problem is the one concerning the effect upon the voice of the insertion of a rugae in a full denture. The question of the differences in acoustical effects which may be obtained by the use of rugae of different sizes and shapes is worthy of serious consideration. Likewise, shall the artificial pattern of configuration be a facsimile of the natural, anatomic one or a modification, and finally, under what circumstances would it be desirable not to use it. Intimately associated with the problem of the rugae insertion is that of the well-known whistling effect, produced after the insertion of full dentures, with or without rugae. It has been shown in the experiments of Boghosian and Spangenberg that a greater alteration of the frequency spectra of vowel sounds, produced, in the front of the mouth, with the front or blade part of the tongue in a high or half-high position, occurs after the insertion of a prosthetic appliance than in the vowel sounds produced in the back of the mouth within all tongue ranges.[13] In view of this fact and in consideration of the dynamics and physiology of production of the consonantal linguodental, inter- and postdental, front palatal and lingual sounds (Figs. 2, 3*a*), it may be better, in the presence of a large tongue and small mouth, or if the function of the tip or blade of the tongue be impaired, to forego the insertion of a rugae or most of one. Certain forms of rugae may, if they contribute markedly to the diminution of the intermaxillary volume, interfere with the favorable production of the normal resonating frequencies and resultant quality of tones of the interdental sibilants S and Z, and the front palatal sounds of CH, ʒ, and SH.

Dewhurst of Philadelphia reported the case of an acoustical engineer, who complained of a difficulty in the production of the sibilant sounds of S and Z,

after the insertion of a set of dentures. The design of the rugae of the maxillary denture took the form and direction of the natural, anatomic rugae, being "transverse" in character. The patient observed, after careful observation, that the current of air, because of the architecture of the rugae, was forced into a "whirl" in the production of the sounds of S and Z, and a whistling sound was produced. He suggested that a ruga of the "longitudinal type" be made, the blueprint of which specified slightly embossed rectangular or spindle shaped elevations in the premaxillary region of the denture to prevent the occurrence of this abnormal phenomena when such sounds were made. The correction was made to the specifications suggested, and the patient was able to pronounce the sibilants properly and in a satisfactory manner.

Sears observed that if the groove or "medium raphe in the tongue is too deep through which the air escapes, the patient will whistle; if not deep enough, he will lisp." In order to correct the whistling he "builds a slight mound upon the palatal surface just posterior to the central incisor teeth to correspond with the incisive pad found normally in the mouth. If, on the other hand, the patient lisps, the medium raphe of the tongue is located, and at a place opposite the depression, a longitudinal groove in the lingual surface of the palatal wax is cut in order that more air can be forced through the narrow aperture to produce the hissing sound." He further remarks that "since the groove in the tongue does not always lie exactly in the median line, any correction in the ruga zone must bear this fact in mind, and that artificial rugae, which were once more widely used, may interfere with the production of a clear SH or sometimes even an S sound."

Proper tongue position and "tension" play a very important role in the production of the consonantal fricative sounds as well as the other sounds of speech. When dentures are first inserted, the patient is presented with a problem of retaining them, and this involves adaptations on the part of the soft mucosa, alveolar and hard bony structures, muscular adaptations and compensations in function of the tongue, orbicularis oris, and adjacent, associated muscular groups. These are associated with the coordinating function of the muscles of mastication to the articulation and the movements of the mandible. Not until the individual has successfully taken the "hurdle" of denture instability can we expect him or her to exercise the finer kinesthetic and tactile controls of the tongue, the successful operation of which is imperative for the production of an efficient and satisfactory speech output. This requires practice, perseverance, and patience, and the patient must be encouraged and reassured of an ultimate, successful outcome.

At times, "the whistling S may be produced by making the tip of the tongue too tense, and the hissing S, caused by holding on to the sound too long or by not controlling the breath stream."[4] McDowell has observed, after the use of skeletal vulcanite plates, or the so-called Hawley retainers, that speech "characterized by very heavy 'SH' and 'ZH' sounds and 'S' sounds which are unvoiced, is produced, and that the very low-pitched whistles, which really are a combination of several S's probably due to an escape of air from several apertures in the plate near the normal position for the blade and tip of the tongue when the individual is not speaking, are responsible for this chorus of sounds

which otherwise might have been clear and distinct."[10] She further states and believes that where retention and stability of dentures cannot be secured, "one cannot expect to eliminate acoustic conditions which will produce several sounds at once each with almost equal intensity."

In the taking of impressions for full denture restorations, we may utilize, in a practical way, some "features" connected with the mechanism of phonation. After obtaining the peripheral seal of our impressions and the post-damming of the maxillary impression, we can check, to a certain degree, the results of our technique and work, through the use of speech tests. Patterns of speech, embodying words having consonantal and vowel sounds, should only be used after they have been analyzed from an anatomic, physiologic and "dynamic" viewpoint, and which are germane to the problem. For the determination of labial and buccal seal, we may employ words containing the bilabial consonantal sounds, P, B, and M, the rounded back vowels, and the labiodentals, F and V, all of which involve, in their production, the active use and function of the orbicularis oris muscle and contiguous structures and musculature.

For the determination of the peripheral seal and stability of the lower impression and base-plate wax "set-up," we may employ words or phrases embodying the linguodental sounds of T, D, and N; the interdental and post-dental sounds of S, Z, and θ; and the front palatal sounds of SH, ʒ, and CH (Fig. 3*b*). If there is a movement and dislodgment of the dentures under these tests, we may conclude that it may be the result of an overextension of the peripheries, or plate area, and too much contour or improper adaptation. Each one of these factors or a combination of two or more may account for the break in adhesion and instability of the dentures. There are others, of course, and these phonetic tests are merely to supplement divers others which are generally employed for this purpose.

After the bite blocks are made and inserted, certain tests, observations and records are made and recorded for the determination of their proper length for the restoration of the correct vertical height of the lower half of the face, for the correct occlusal plane, the proper contours, for intermaxillary clearance, and for the determination of the posterior boundary of the maxillary denture. For some of these ends we may employ and utilize the functioning speech apparatus. The fullness of the bite plates and later the wax set-up of the teeth can be checked as for their correctness not only by observation but by the use of words which contain the bilabial stop sounds of P, B, and M, for if they are too full there may be an interference with the functioning of the orbicularis oris and its adjacent musculature, which can be observed if the sounds of P, B, and M, are poorly and indistinctly pronounced. After the upper bite plate has been made so that its incisal segment is on a horizontal plane extending slightly below the lower border of the lip at rest, and parallel with a line drawn through the pupils of the eyes, and the occlusal plane is parallel to a line connecting the external auditory meatus and the alae of the nose, the lower bite block is built to meet it, following which we are to determine if the correct vertical height in relation to the upper and total face height has been made.

The intermaxillary bite opening must meet and be in harmony with all the physiologic requirements of mastication and phonation. For the determination of the proper intermaxillary clearance the test generally used has consisted of the pronunciation of the word Mississippi, spelled phonetically ˈmɪsɪˈsɪpɪ and with Webster's diacritical markings mĭs′ ĭ sĭp′ ĭ. The consonants M and P are sounds in the same phonetic bilabial group, produced by lip movements and if difficult of pronunciation may indicate an overextension of the plate outline, too much fullness in the bite plates or trial set-up or too great an intermaxillary separation. The intermaxillary separation varies approximately from $\frac{1}{20}$ of an inch to $\frac{1}{12}$ of an inch with the pronunciation of the syllables mĭs, ĭ, sĭp and ĭ. The four vowel sounds of ĭ and ĭ are produced approximately alike in the front-high position of the mouth with the blade of the tongue situated high in the premaxillary vault area, and pronounced as the ĭ in city and six (sĭks) (Fig. 4*b*). One may determine with the use of this word the clarity and quality of the sibilant S, or the presence of any mutations of sound which assume the characteristics of lisping or whistling. The important point to remember is the need for a thorough understanding of the objectives desired and the means taken to attain them. As a result of the splitting up of the word Mississippi into its component phonetic parts and observing the functional effect of each sound component we may readily deduce that a simpler combination of the sound elements would serve the same purpose, as for example, in the pronunciation of the word "misses" the equivalent data may be obtained as from that of the pronunciation of the word "Mississippi." Likewise, other sound combinations, for this test and other purposes may be created.

The pronunciation of the sound of ɑ: as in father (fɑ:ðə) (Fig. 4*b*), for determining the junction of the soft and hard palates, a record useful in marking the posterior border of the maxillary denture, is a well-known and accepted procedure. It is based upon the fact that in producing the sound a: the lips are unrounded (Fig. 6), the mouth is wide open, and the tongue is almost flat, though slightly curved, making the posterior palatal region clearly visible for observation and marking. The soft palate is raised when this vowel sound is emitted, an action characterized with the emission of all the vowel sounds, and the oropharynx is walled off from the nasopharynx, permitting the vibrated column of air to pass only through the oral cavity. The sound of ɑ: in the words of "bar" and "art" is the same as the ɑ: in "father."

The problem of the setting up and arrangement of the anterior teeth merits close consideration, not only from the point of view of esthetics but from that of phonetics. The individual effect of the rotation, separation or overlapping of the incisor teeth, upon phonation demands critical thought. Since 70 to 80 per cent of all phonetic sounds have their origin or modification in the anterior part of the mouth, it seems most logical to conclude that only a labiodental facade which will contribute favorably to an assist in the functioning of the physiologic mechanism concerned therewith, should be constructed. In the construction of dentures the twelve incisor teeth should have a symmetrical design, meeting all the individual requirements of the mechanics of articulation, and reflect a satisfactory esthetic effect chiefly through differences in size and shape, and color variations. Any modification of this general rule, such as a slight

separation of the two or more incisor teeth or the rotation or lapping of one or more teeth, should only be attempted after a discriminating evaluation of the speech output of the patient, and the determination, by a series of phonetic tests, of the effect of such a construction on the "phonetic index" of the patient.

The field of study in phonetics is limitless, and it behooves us to observe, investigate, and record data concerning this all important, though perhaps neglected, branch of the dental healing art, in order that we may learn something of and be more enlightened upon this subject, as a result of which we may be able to assist in alleviating the mental and physical suffering of those afflicted with speech disabilities. It is a noble task and one worthy of our earnest consideration.

CONCLUSION

Sound is a form of energy and may be considered as a series of vibrations of the air of such frequency, or pitch, that it is audible to the normal human ear. The sounds of speech are complex, being composed of many simple sounds, each of which has a fundamental frequency (pitch), amplitude, and tone quality (timbre).

There are three basic fundamentals for the production of normal speech: "correct breathing and proper utilization of breath; correct kinesthetic or muscular imagery, which is designated as the oral position or Oratans; and a combination of one and two. The resultant of these three steps, the production of oral expression, is predicated on the assumption that the individual is possessed of integrated mental processes and is endowed with a normal instinctive urge for speech."

The origin and basis of the oral phonetic curve are explained. The use and application of the sound groups in the curve, in conjunction with those of the vowel and diphthong charts for the determination of normal and defective speech, before and after dental and oral restorations, are elucidated.

For this purpose, the use of simple words, phrases or sentences is advocated, stress being placed upon a thorough analysis of the sounds comprising these words, phrases, etc., with due regard and understanding of the anatomy, physiology and dynamics associated in their production. This concept is amply illustrated in the charts, and its application, with regard to normal and defective speech in cases of cleft palate, harelip, tongue abnormalities, dental and oral pathologies, and maloclusions, is described.

A critical discussion of Boghosian and Spangenberg's experiment of "the effects of a dental prostatic appliance on the quality of the voice; an experimental study" has been delineated because of a desire to throw some light upon the important role which anatomic and physiologic factors play in speech production normally and after the insertion of prosthetic appliances. Emphasis is also placed upon the need for further investigation of the acoustical properties of prosthetic materials and the effects upon the quality of the voice in the use of them.

The effect of the location of lingual and palatal bars, the insertion of rugae, intermaxillary jaw relationships, tooth positions and malocclusion, partial

and full dentures upon the speech apparatus has been merely sounded, and awaits a more penetrating and thorough investigation.

By the use of the spoken word our thoughts and ideas are conveyed to our fellow men. How necessary it is for us to guard, improve and nurture the mechanism which makes it possible!

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THE RESULTS OF THE USE OF THE SLIDING YOKE

WILLIAM R. JOULE, D.D.S., KEARNY, N. J.

IN THE presentation of this case report it is desirable to bring to attention a means of effecting distal movement by means of the sliding yoke.

The sliding yoke is not original with me, being first presented by Dr. Calvin Case and more recently in a newer form by Dr. Spencer Atkinson. An adaptation of the mechanics of the sliding yoke to the edgewise mechanism will be seen in Fig. 1.

Fig. 1.

Fig. 2.

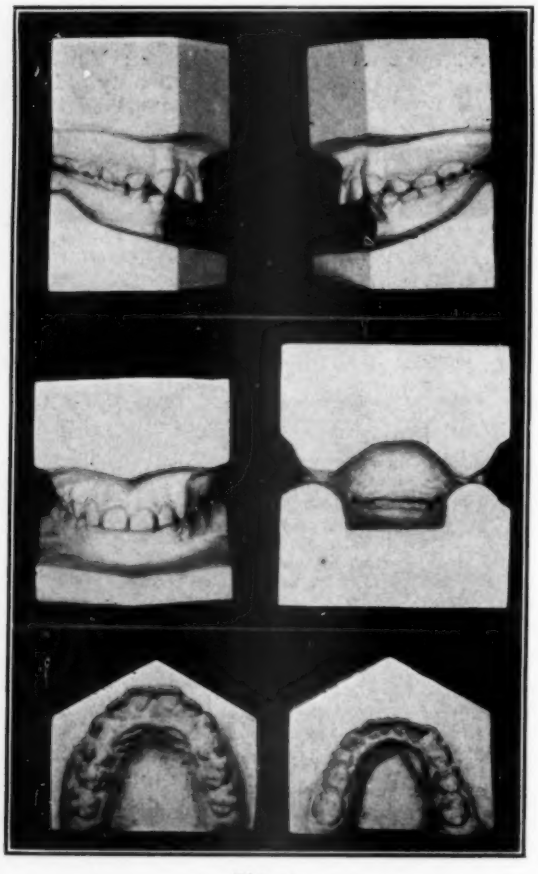

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.

Read before the New York Society of Orthodontists, Nov. 14, 1939.

This consists of a section of .030 round wire, cut and bent to the desired length, soldered to the two parts of an edgewise tube, .022 by .028 by ⅛" which has previously been sawed in half. A small hook of .025 round wire for the elastic is also soldered to the end of the .030 wire at its mesial curvature. The soldering of these component parts is done on a section of the edgewise wire, .022 by .025.

The case herewith presented was not selected because of ultimate finished result, but for the gratifying distal movement that took place as explained later.

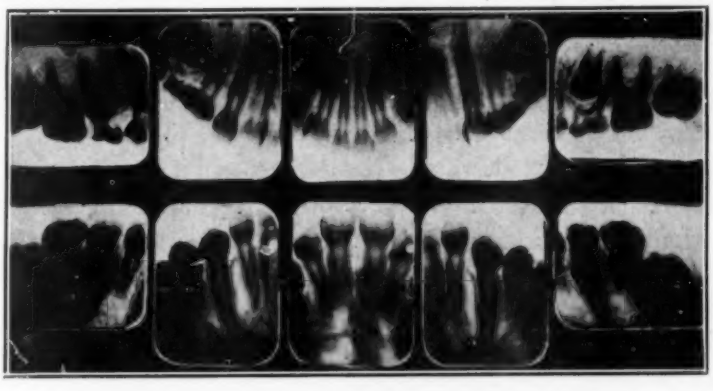

Fig. 7.

Figs. 8 and 9.

The patient was a girl, aged 10 years, with good physical development. She was a full-term breast-fed baby and had as childhood diseases, chicken pox and measles. Tonsils and adenoids were present and enlarged. Figs. 2 and 3 show right and left views of the casts.

Fig. 4 shows an anterior view and Fig. 5 depicts the casts from the lingual. The degree of overbite is clearly discernible.

The occlusal view of the casts is shown in Fig. 6.

In Fig. 7 the full mouth x-rays are shown.

The second premolars were not yet erupted, and there was a tendency toward retention of the deciduous second molar roots in the mandible. From the view of the full face, Fig. 8, the shortness of the upper lip with a hypotonicity and a tendency to a mentales muscle perversion with hypertonicity are clearly apparent. Fig. 9 shows profile photograph before treatment.

The case was gnathostatically diagnosed as a maxillary incisal protraction with asymmetrical lateral protraction, combined with a mild contraction and abstraction symmetrical.

This maxillary condition had associated with it a total mandibular retraction with a mild contraction and attraction.

According to Angle classification it could be classified as a Class II, division 1.

Because of certain circumstances the patient did not start treatment immediately, and by the time the patient was next seen by the operator, she had exfoliated the maxillary second deciduous molars and the right mandibular deciduous molar. The premolars in these regions had already assumed their positions in the arch. The mandibular left second deciduous molar roots showed radiographically lack of resorption, and the tooth was therefore advised removed. The second premolar uneventfully took its place in the arch.

Treatment consisted of banding all mandibular incisors, canines, and premolars with edgewise bracket bands. The mandibular first molars were banded with an edgewise tube, buccal, .022 by .028 by ⅛″ and a half-round tube, lingual. This half-round tube was used later in retention. An edgewise arch .022 by .025 was then fitted passively to the mandibular bands so that maximum anchorage was obtained with least disturbance of bone. This arch was originally shaped to an archeograph or general arch form.

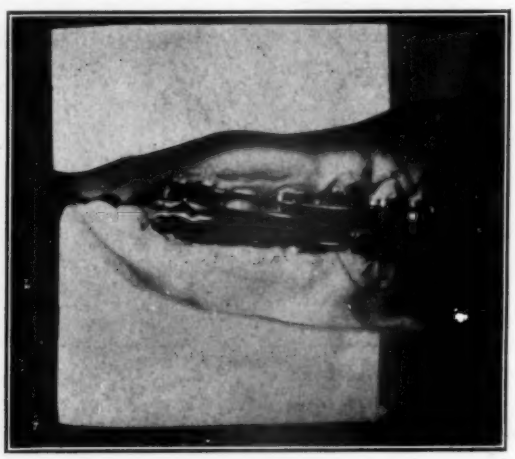

Fig. 10.

The maxillary denture was banded with the same bands and attachments as the mandibular with the exception of the half-round tube on the lingual of the molar bands. A round wire, .020 gold platinum, first shaped to archeograph or general arch form was inserted for a "limbering up" period of time. This was followed in sequence over a two-month period by a round .022 wire and an edgewise arch wire, .022 by .025 carefully adapted in the incisor area, so as not to torque the incisor roots labially.

This .022 by .025 edgewise arch wire was fitted with the sliding yoke in a manner shown in Fig. 10.

The continued use of a medium-size intermaxillary elastic for a period of three and a half months resulted in distal movement of the maxillary molars

combined with a shift mesially of the entire mandibular arch until the correct inclined plane relation was established. At this point in the treatment the yoke was shortened so that the distal end was brought to engage the mesial of the bracket of the second premolar. This had already moved distally slightly, due to the peridental membrane fibers. A stop was then placed mesial to the molar buccal tube. Elastics were continued until the second premolars had assumed their proper contact with the maxillary molar and the proper occlusion with the mandibular teeth. This procedure was repeated with first premolars, the yoke was shortened proportionately, and the stop on the arch wire was transferred to the mesial of the second premolar bracket.

Fig. 11.

Fig. 12.

Fig. 13.

Fig. 14.

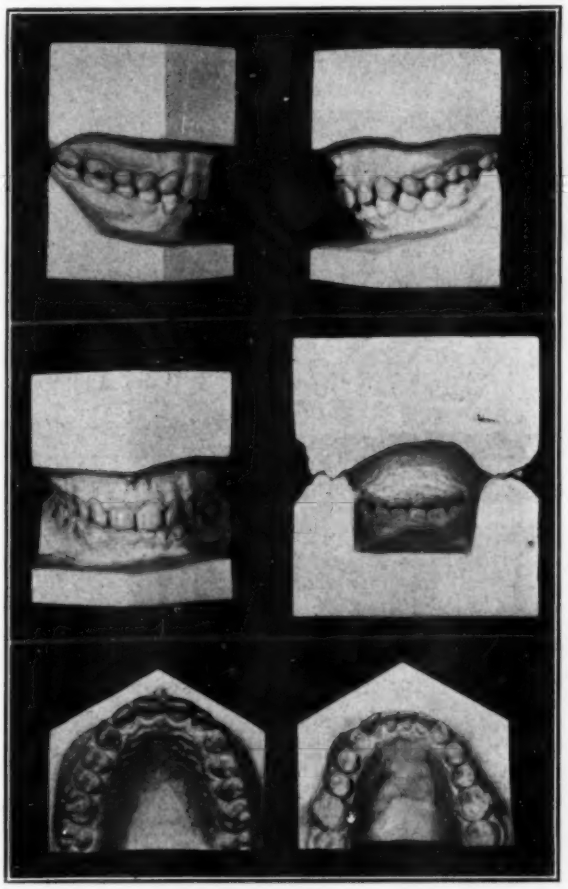

Fig. 15.

In the distal movement of the canines the small yoke was used mesial to the canine brackets. This yoke was the mesial portion of the original longer sliding yoke. The stop on the arch wire was at this stage mesial to the first premolar bracket. After the canine teeth were moved distally into contact and interdigitation, the edgewise arch was removed and a round wire, .022 gold platinum with intermaxillary hooks in the canine area, was inserted. By the use of the intermaxillary elastics the axial inclination and labial positioning of the incisors was corrected.

The reinsertion of an ideal arch form arch wire .022 by .025 in the maxillary denture and the rounding out of the mandibular arch wire to ideal arch form

completed the appliance therapy. Retention was instituted with a modified Hawley retainer bite plane set-up in the maxillary denture and a lingual arch wire .036 in the mandibular denture.

Figs. 11, 12, 13, 14, and 15 show the right and left lateral front, lingual, and occlusal views, respectively, of the casts after treatment.

The opening of the bite due to gain in vertical height is clearly portrayed.

Fig. 16 is the radiographs taken at the termination of active treatment.

Figs. 17 and 18 show the full face and profile of the patient after treatment.

The type of basic mandibular structure that this individual presented led to a rather disappointing esthetic result, although the occlusion settled to a correct inclined plane relationship.

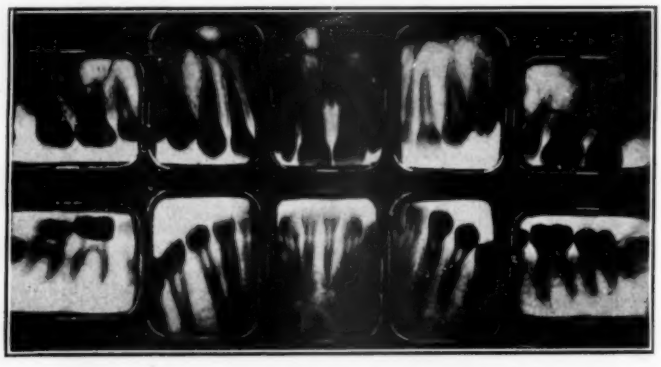

Fig. 16.

Figs. 17 and 18.

Muscle exercises of the orbicularis oris and masseter types were advocated to increase orbicularis oris tonicity and to settle inclined plane relationship.

The distal movement of teeth, especially molars, in an upright position with lack of tipping, the ease of manipulation, and simplicity of technique, combined with control, seem to be the cardinal advantages of the sliding yoke. While the sliding yoke brings satisfactory movements with the edgewise arch mechanism, it can be and has been readily, adapted to the labial lingual appliance and ribbon arch therapy.

A STUDY IN TEMPERING PRECIOUS METAL ALLOYS

FREDERIC T. MURLLESS, JR., D.D.S., HARTFORD, CONN.

SEVERAL years ago I compiled some material concerning the metallurgy of orthodontic alloys, a part of which was contained in some lectures that were given before the Harvard Forsyth Post-Graduate School of Orthodontia, sponsored by Harvard University, under the direction of Dr. Alfred P. Rogers. Little of this material was ever offered for publication, but on account of my continued interest in the subject, and the books and material which I have accumulated, I am bringing you the present paper.

No one doubts the statement that many a threatened calamity has turned out to be a blessing in disguise, and that what has seemed at first a serious difficulty, may be seen in time as a landmark in the path of progress. Let me remind you of such an instance in the history of orthodontics.

Platinum and 10 per cent iridio-platinum were fast becoming the accepted materials for orthodontic appliances, when in the days of the World War there came a great wartime demand for these metals, which made the visible supply seem wholly inadequate. This led to the restriction of their use for every other purpose, and for a short time every such use was totally forbidden. It was with extreme apprehension that it was realized that neither platinum nor iridio-platinum were longer available for orthodontic appliances because of an edict from the War Department at Washington.

Soon, and as the result of protest and appeal, this restriction was somewhat relaxed, but the price of platinum had by then become prohibitive, and the necessity for finding a substitute for use for orthodontic purposes still remained. It was under these circumstances that a series of expensive experimental tests, extending through months, was undertaken by a firm of metallurgists at the suggestion of a committee representing the Eastern Association of Angle Graduates. After several months as a result of this research the committee reported in May, 1918, that alloys for band material and arch wire had been selected, and that these were found to be surprisingly more efficient than the platinum metals which they were designed to replace. In these new alloys, without seriously lowering the coefficient of ductility, the power to resist deformation was remarkably increased. The new alloys, accepted by this committee after a long series of tests, were so great an improvement over any metals previously employed in orthodontics that the use of iridio-platinum was abandoned without regret.

Almost simultaneously every manufacturer in the country rushed forward with his own line of gold-platinum-silver-copper alloys. Though at the present somewhat standardized, there has been from the first quite obvious lack of uni-

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formity in the behavior of these different alloys, variously attributable to composition, technical difficulties in smelting and manufacture, neglect of proper laboratory technique for soldering and shaping. These difficulties have been greatly lessened through the development of dependable facilities for laboratory tests, and the determination of dependable bases for comparison along the way.

Efforts of metallurgists at the beginning were concentrated upon producing wire of high elasticity, both by perfecting the homogeneity of the alloy, and through intensive use of the drawplate, which last was itself a severe test of the fitness of the specimen. To metallurgists and orthodontists alike, this was an entirely new field, and experience and observation were almost the only resources.

Often the means and method by which wire of one formula was compared with another were too indefinite to be conclusive. For instance, one formula might be more susceptible than another to molecular or crystalline changes through a bad soldering technique, but the fact was not apparent until the appliance was subjected to the test of use. Often the interval between trial and failure was so long that the incident had lost force, or even escaped notice.

These and kindred difficulties have occurred in my experiences repeatedly, and most probably to some degree have befallen you, also. Some wires, though definitely elastic, were so rigid that it was difficult to shape them to the model without marring them badly with pliers. In a wire of this type every bend becomes a structural injury. Some materials did not flame-temper readily, nor in a way that helped to overcome such inequalities in texture as are incident to soldering. This has been especially so in pieces which have been soldered repeatedly. With these and many often recurring and similar experiences in mind, I have been experimenting for a long time with the various available devices for heat-tempering the precious metal alloys used in orthodontics, but with a growing conviction that the possible efficiencies of our orthodontic appliances were not being realized.

As is incident to the manufacture of any unfamiliar commodity, it was soon found that very slight changes in the proportions of the metals entering into the composition of orthodontic alloys were accompanied with wide variations in such physical characteristics of the finished product as tensile strength and hardness. In fact, in those earlier days, and even afterward, no one seemed to see clearly how relatively unessential to our purposes are what is conventionally recognized as tensile strength and hardness, as means of measuring the highly important property of elasticity.

The composition of these alloys and their response to annealing, as a control of the fragility induced by the drawplate, have been the principal causes for anxiety on the part of all concerned.

We are all familiar with the definition which says that ductility is that property of matter by which it may be drawn into wire, and we know that the limit of ductility varies with each metal or alloy. The drawing of wire disarranges the normal atomic relation and deforms the crystalline structure which the metal had assumed as it cooled after melting. This crystalline arrangement

is as definitely its own as a man's handwriting is a personal characteristic. Each combination of like elements and like quantities, under the same physical conditions and sequences, will produce the same material when frozen. At the same time, under stress each formula has its own reactions and limitations and weaknesses, which it is desirable to understand both individually and in principle.

As wire is drawn in the process of reducing its diameter, it assumes a rigidity that is one expression of an acquired stress internally, which makes it resilient. This atomic and crystalline disarrangement is also expressed as an acquired brittleness and fragility. Annealing or, by the newer nomenclature, "tempering" is resorted to for the purpose of permitting the crystalline structure of the wire to at least partially readjust itself.

The tire of overstressed metal, as in drawing, does not cause it to "crystallize and break" as is often said, but does destroy the integrity of the crystalline structure so that the object is gradually weakened and finally breaks. In this respect the comparison to the condition of a frayed and broken rope is good.

In the drawing of wire, the atoms of a metal or metallic alloy slip upon themselves much as a pack of cards do, and under the microscope show dark lines or slip bands crossing the faces of the metallic crystals. These are checks in the crystal itself, and are the boundaries of steps formed by the straining which is incident to the wire drawing.

This straining involves changes in the relative position of some of the atoms and the breaking of some of their interatomic bonds. The resulting dark lines in the facets of crystals indicate the point of subsequent fracture. Fragments so formed may or may not adhere to each other. Wherever these fragments remain sufficiently in contact the crystalline structure may be reconstructed to some degree, under favorable conditions. The capacity of metals for recovery through heat treatment depends somewhat, no doubt, on whether the slip-planes are in the same line and near together so as to be in effect continuous, or whether they break joints, as we say of brickwork.

Annealing, if properly completed, tends to restore the metal to its natural crystalline condition and to remove the hardening effects of strain.

The process of annealing in most metals, it is said, occurs in two stages, which sometimes overlap in different parts of the same piece of metal. There is, first, the simple effect of more or less complete mechanical softening, leaving the strained structure apparently unaltered, followed by the process of gradual recrystallization by which new crystals are produced and gradually increase in size.

One very important point must, however, be borne in mind. If metal is annealed after cold working with the object of fitting it to stand further cold working, it becomes important to allow the second stage of the annealing process to continue for a certain time, so that a renewed crystalline structure of moderate size may be developed. The reason for this is that there appears to be a definite limit to the amount of distortion which can be applied safely to a given metal without producing too extensive fracture of the crystals. There is some reason to believe that if a metal is only just softened by slight annealing without per-

mitting the growth of new crystals of moderate size, its power of safely undergoing further distortion is more limited than it would be in a more thoroughly annealed condition.

In the preparation of the finished product, the cast ingot from which the drawn wire originates is first reduced in diameter by hammering and afterward passed through diamond dies. At times, determined by experience in reducing the cast ingot to the required size, the wire is repeatedly annealed at a temperature at which the atomic relation, which has been disturbed with the drawing, will most readily adjust itself, and the crystalline arrangement of the alloy will be most thoroughly restored.

It may seem that the tolerance of the crystals to the distortion incident to drawing, together with a comparative freedom from brittleness, and its capacity to renew its moldability under the influence of a favorable annealing temperature, are the measure of the mechanical property called ductility.

It is desirable that the alternations of drawing and annealing should be so timed that the wire, when it arrives at the required size, has the highest practical degree of elasticity with the least accompanying brittleness, after which it is heat-treated to a point at which it is in practical working condition for our uses. Every change in form made thereafter by cold working will increase its brittleness, even to the point of fragility, and will subtract from the capacity of the material to express force.

One of the most important mechanical properties of metals is what is called the proportional limit of the material. This term may be explained somewhat technically as follows: when force is applied in bending a wire, there is a range of movement in which its form is not permanently changed. This is an evidence or expression of both its elasticity and resiliency. But by gradually increasing the load in a testing machine, the elastic capacity of the specimen may be exceeded and the yield point thus be reached. The specimen is now deformed beyond recovery, and it is no longer resilient, though its resistance to bending has not been completely overcome. As the load is further increased it soon begins to yield disproportionately to the constantly augmented stress. This marks the so-called proportional limit of the tested material. Beyond this point the yield to stress, as shown in recordable movement, is increasingly great in comparison to the additional force employed.

In orthodontic practice all our processes tend to mar the finished material, no matter how efficient it may be, and by bending it, to rob it of its elasticity and lower the point at which it will yield to stress, and break in use. In short, every touch of the pliers takes something out of the material.

The internal structure of a finished wire may be believed to be already in a condition well toward its limit of endurance. Whether by shaping for use as a labial arch, or by winding the wire on a mandril to make a coiled spring, or by shaping it to make an auxiliary spring, the crystalline relation is subjected to still further strain and deformation, and its capacity for effective resistance to stress is lowered to a minimum. In actual experience each finger spring we place is individually subject to all the vicissitudes of trial and error—to an

experiment in which an untried force is pitted against an unmeasured resistance. Every adjustment of the finished appliance robs the material of some part of its abnormally acquired capacity for the desired reaction.

In the hope of saving the integral efficiency of the material, at least in part, and to avoid placing unnecessary stress upon it in the process of handling it, I have for a long time asked to have all wires annealed with extreme thoroughness before delivery to me. This gives a waxy texture that is extremely adaptable and capable of being shaped with a minimum of effort and with few plier marks. At least theoretically, it secures a uniform crystalline structure as a basis for such tempering of the finished appliance as I have been able to give it, and has furnished a background for such experimental variations of timing and temperature and method, as have occurred to me. I strongly recommend that all wires intended for orthodontic purposes should be furnished in this state.

On the whole, notwithstanding my interest, and an experimental attitude, my efforts have seemed futile and discouraging. Recently, however, I have found a way of restoring and actually increasing the resiliency of the gold-platinum orthodontic wire beyond its original manufactured condition, and already I seem to have had sufficient experience with it to warrant my bringing it to your attention.

By this means a piece of orthodontic wire may be shaped to any form desired and with six to ten minutes of heat-treatment the material, after the tempering, will, by laboratory tests, show greater elasticity, a higher yield point under stress, and a higher proportional limit than has been furnished in the finished wire. In practice a .022 spring so tempered will apparently show greater efficiency than .025 wire otherwise tempered.

Checks and graphs which are available for your study have been made for me by the cooperation of a well-known metallurgist who has made these tests upon unidentifiable specimens from a number of our best manufacturers. All of these specimens have been found to give a reasonable uniformity in their responses to the tests. This makes it possible for all of us to try out this process of tempering upon the materials with which we are most familiar.

The principle employed in this method of heat-tempering is that of a bath in a mixture of melted potassium and sodium salts held at an optimum temperature, which was found by accurate laboratory tests of the treated specimens. The timing of the period of heat-treatment has also been carefully checked. This method is neither original nor new, the idea having been employed already in the arts in other directions.

The possibilities of the use of this method of heat-treatment of orthodontic alloys came to me when I saw a very attractive and ingenious electric heater devised by Dee and Company for the purpose of heat-treating gold castings for restorations in bridgework. I ordered one of these heaters at once with the idea of experimenting with it. By laboratory tests it was found that while quite efficient for the purpose for which it was designed, the heating element did not afford sufficient heat for the best results with orthodontic wires. It was taken apart, the heating element was stepped up, and the timing checked by

repeated tests until it was found that with the right temperature and timing, a degree of elasticity could be established in the treated wire much beyond what could be permanently produced by the drawplate. The resultant recrystallization of the wire through this heat-treatment, following the bending required in shaping the material, gave the appliance a definite and dependable efficiency. This in effect means that the completed appliance in its new form may give greater efficiency than can be induced in the original wire by drawing.

I have already said that it appeared in practice that a spring of .022 wire thus became capable of work comparable to that of .025 wire under the old conditions. The .025 wire which had been heat-treated by a conventional method, was efficient when first applied, but soon showed tire and a diminution of force. Wire of .022 size which had been treated in the new bath, while less aggressive under like conditions when first applied, worked much more evenly toward its point of rest and with less fatigue.

In practice, to avoid too great activity, care should be taken to see that the arc of movement, given in adjusting a spring made of even this smaller wire, is somewhat less than has been the practice under the usual methods of heat-treatment.

There are practical advantages in this method of heat-tempering, because irregular pieces when submerged are evenly tempered throughout, while in flame tempering, even and accurate heating is not possible nor it is possible in a heater where the appliance does not rest evenly on the heating surface.

One of the most important advantages of this method lies in the fact that each shaped spring added to the fitted lingual arch, when so heat-tempered, has gained renewed and increased power to begin to perform its desired work and with a uniform texture.

By these laboratory tests which have been made for this project, it can be shown that pieces which have been heated to correspond with the average temperature of soldering, show an average increase of 38 per cent efficiency after heat-tempering in the heated salt solution. When changes in form are made later in the same appliance a few moments of retempering renews its potential activity noticeably.

I am expecting that on account of the uniformity of re-established crystalline structure under this newer heat treatment, lingual arches will not break so readily at the anchor posts, and that the danger of breaking lingual arches, while being radically reshaped to conform to tooth movement, will be greatly lessened.

You will be interested to have me tell you that the tests for these reactions which I have referred to have been carried through impartially, with specimens of wire from four of our leading manufacturers, and that these specimens were identified in the laboratory by symbols which were known only to one disinterested person. For comparison the same tests for elasticity, resiliency, and proportional limit were given at the same time to a sample of chrome alloy wire which is subject in use to practically the same reductions in efficiency through bending and shaping as the wires of the gold-platinum group. The trend toward passivity is in corresponding steps under the same technical handling, but heat-

treatment of chrome alloy wire was found to further diminish its mechanical properties to a very definite degree.

Chrome alloy when tested by the fingers gives a wrong impression and one quite contrary to the facts. It is worthy of especial note that in these tests, on account of its rigidity and lack of elasticity, the chrome alloy wire, in response to the same force, will bend only about half as far without permanent distortion as wires of the gold-platinum group; i.e., its proportional limit is only half as high, and so it can move a tooth only about half as far before it must be readjusted for further treatment. At the same time the extra bending of this further adjustment again reduces the original efficiency of the material through the loss of irreplaceable qualities because it cannot be heat-tempered. The initial resiliency of chrome alloy is only 20 to 25 per cent of that of the precious metal alloys, which means that the precious metal specimens upon which tests were made were four to five times as capable of expressing continuous force through their resiliency as the chrome alloy specimen.

Needless to say my sense of the comparatively higher value and usefulness of the precious metal alloys for orthodontic purposes over those of chrome alloy has been more than confirmed by every detail of this investigation.

Since writing this paper which has been offered to Mr. Shell of Dee and Company for his suggestions, I nave received from them a heat-treater designed for use with orthodontic wires and which is quite equal to the one which was reconstructed for our experiments. Though up to that time unannounced in their literature, I am glad to say that such a heater is available so that all who wish may secure one with which to try for themselves this method of heat-treatment of orthodontic wires.

It is a pleasure to acknowledge the friendly interest and generosity of The J. M. Ney Company and their metallurgist, Mr. Richard L. Coleman, in making the somewhat expensive tests necessary for this investigation, for which I asked in my desire to disprove or confirm my observations.

43 Farmington Avenue

DISCUSSION

Dr. Richard H. Stucklen.—Those who have been working along the line of heat-treating their wire I am sure will agree with everything Dr. Murlless has said.

The apparatus needed for heat-treatment may possibly be simplified from that which Dr. Murlless suggested. The salt mixture which he used can readily be trusted in connection with a tripod and a Bunsen burner with a thermometer capable of reading temperatures up to 1000 degrees Fahrenheit.

We all know of the progress made in the various materials since the American Dental Association has been cooperating with the National Bureau of Standards. They gave us a specification known as No. 7 in 1932, which has been of great help. However, since then a great many alloys, usually of a higher palladium content, have been developed. These do show certain advantages, namely, a high resistance to tarnish and a high fusion temperature, although they are particularly difficult to "pickle." Some of these alloys have a particularly high resistance to injury in soldering. Their fusion temperature usually runs around 2000 degrees Fahrenheit. They are particularly elastic, namely, they have a very high percentage of elongation, particularly after a heat-treatment, as Dr. Murlless said, requiring five or ten minutes. This means, that one can use a thinner wire, and have at least the same strength

with greater resilience; and it also means that one has a very tough wire which can be bent a great deal. The resistance to injury in soldering may be interpreted as a lack of the segregation of these crystals, which so often happened and weakened our alloys that we have used in the past. I might say that some of these alloys are even helped by using a high fusing solder.

Dr. Samuel Herder.—What wire have you found most acceptable as far as the various types of wire that are being sold on the market for orthodontic work are concerned?

Dr. Frederic T. Murlless, Jr.—I think, perhaps, I should not say what my experience has been in regard to that. I am not engaged in advertising anybody, and on the other hand I should not want to say anything by implication derogatory to anybody's product.

In reply to what Dr. Stucklen has said, it is probably true that a sauce pan effect and a tripod might be used to melt potassium-sodium salts, but with so high a temperature and with an apparatus that is not perfectly secure, one might be badly burned. Even a spatter of the solution at 700 degrees would make a serious burn and a permanent scar. I recommend that anyone who is interested should try an electric heater. This will give the desired temperature and an opportunity to study the timing so as to get the best result with the gold-platinum alloy with which one is most familiar.

RETENTION PROCEDURES

FRED E. MCINTOSH, D.D.S., LOS ANGELES, CALIF.

THERE is a growing belief among thoughtful orthodontists that the problem of retention needs more emphasis. We have been too concerned with our treatment problems to the neglect of the problem of maintenance after treatment.

Since chrome alloy has become the principal material used in orthodontics, it appears that methods of using this material for retentive measures have also been neglected. It is my purpose to extend its usefulness by revealing methods that have proved successful in my practice.

Having found the mandibular canine-to-canine retainer very satisfactory, a technique was developed for its construction. The canine bands are placed on the teeth, and a modeling compound impression is taken. The bands are removed and placed in the impression.

In order to facilitate the removal of the bands from the model after pouring, a film of vaseline is placed over the inner surface of the bands. The impression is poured with artificial stone.

Fig. 1.

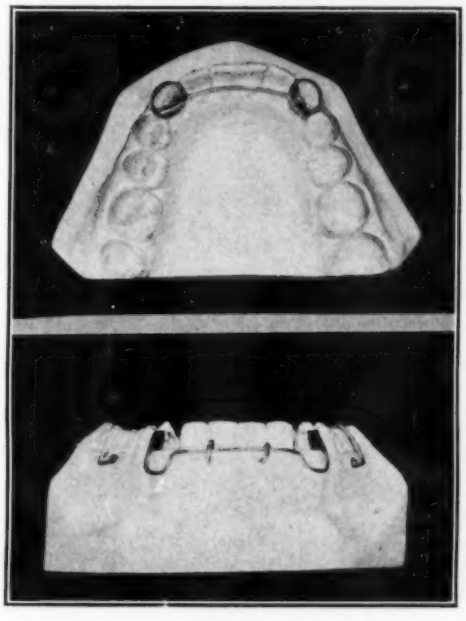

Fig. 2.

The compound is softened and removed. Freeing of the contact points will allow the bands to be removed from the teeth. The bands should be thoroughly cleansed.

A piece of .022 by .036 chromium material is contoured to fit the lingual surface of the left canine band. The lingual bar is then spot-welded to the band in a freehand method and replaced on the model. With pliers the bar is

shaped to fit along the lingual surfaces of the teeth to include the right canine. The annealing points may be used to advantage in adapting the bar.

In order to establish the relationship of the bar and right band for spotting, a mark is made on the band with a sharp instrument parallel with the top surface of the bar resting across it. A second mark is made at right angles to this across both bar and band. The bar and both bands are then removed to allow spot-welding of the right band.

The appliance is then returned to the model and adjusted with pliers for any slight discrepancies or placed on the model and adjusted, with the annealing points. Fig. 1 shows the completed retainer on the model. This retainer can be made direct without the use of a model, after skill has been developed in the technique.

LOWER HAWLEY RETAINER

This appliance worn in conjunction with the canine-to-canine retainer is a very serviceable appliance if constructed in the following manner. The canine-to-canine retainer previously described is cemented to the model.

Fig. 3.

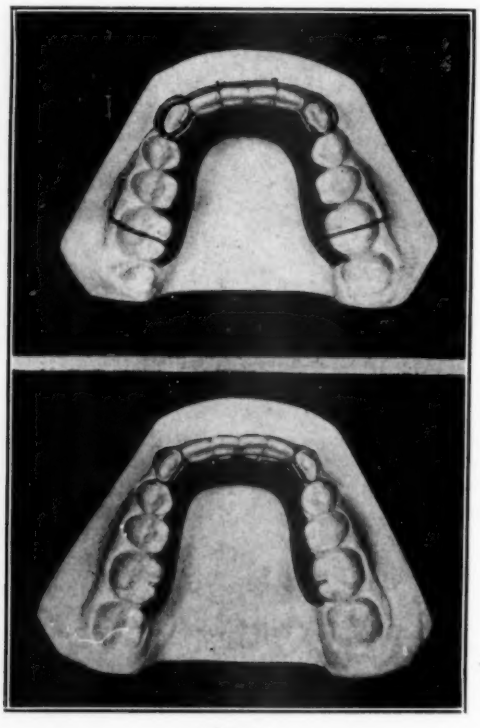

Fig. 4.

Holes are drilled through the model gingival to the bar from the lingual through the approximal spaces distal to the central incisors, with a round bur. A piece of .025 wire is then bent so that it can be embedded in the vulcanite and touch the bar as it passes through the opening. It should extend far enough through to make it firm in the plaster on the labial surface, in the investing plaster for packing.

Occlusal stops are made on the molars in the usual manner leaving them long enough to be invested. The waxing and vulcanizing are then completed. Fig. 3 shows the appliance ready to be invested.

After vulcanization the anterior extensions are then cut off so that they engage the gingival surface of the bar. The molar occlusal stops are cut, and ends smoothed down. The vulcanite should not be allowed to come in contact with the canine-to-canine bar as it may cause binding. A .030 wire can be embedded in the vulcanite for added strength. Fig. 4 shows the appliance in position.

In seating the appliance the two anterior projections are placed under the bar from the distal, pushed forward, and then the heels of the appliance are carried to place with a slight snap. The patient cannot dislodge the anterior portion of the appliance with the tongue as he was able to do with the earlier designs. A labial bar may also be added to advantage where there have been extensive rotations as shown in Fig. 2.

Fig. 5.

Fig. 6.

In cases where there has been diastema in the maxillary central and lateral region it has been found difficult to keep these spaces entirely closed with the average Hawley appliance. A method is shown for controlling this space in Fig. 5, consisting of spurs which can be adjusted, embedded in vulcanite. In this case a small amount of additional space would be of advantage in the canine region. To allow the construction of these spurs the plaster on the distal of the lateral incisors is scraped a slight amount to allow a .025 wire to be carried

across this surface. Sufficient length should be left on the mesial end for investment while waxing and packing.

After vulcanization the wires are clipped shorter and can be made thinner if desired to fit above contact points. When these are bent a slight amount toward the mesial, it will aid in keeping the spaces closed, and will serve as an adjustable control.

A "bite stop," which in reality is a very shallow bite plane, is shown in this case which is of advantage in holding depressed anterior teeth; it will also be of valuable assistance in retaining mandibular anterior teeth where they were badly rotated. If the distal part of the maxillary Hawley is finished to a feather edge and an irregular edge given from molar to molar area, the patient does not notice this junction with the soft tissues. A slight scraping of the cast before waxing will give a postdamming effect in this same region which adds to stability.

In Fig. 6 one of the acrylic resin transparent materials has been used instead of vulcanite. This material seems to have great possibilities for retainer construction. It has a definite appeal from its appearance and is more sanitary. The appliances can be constructed in the orthodontist's own laboratory, with the addition of a minimum amount of equipment. The material does not need to be vulcanized.

1158 Roosevelt Building

STUDIES CONCERNING THE ORAL CAVITY AND SALIVA

II. Biting Pressure. (2) Measurements of Biting Pressure in Children*

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THE subject of gnathodynamics has received considerable attention in the past. This is evidenced by the large number of papers written about the subject. In Table I are shown some of the relationships studied along with the reference numbers of the different investigators.

Table I

Former Biting Pressure Studies With Reference Numbers and Relationships

MASTICATION	MALOCCLUSION	MOVEMENTS	MEASUREMENTS
1, 2, 3, 4, 5, 6, 9, 10, 11, 12, 13, 16, 17, 18, 19, 20, 23, 25, 26, 27, 28, 29, 30, 33, 34, 35, 38, 39, 40, 41, 46, 47, 49, 50, 52, 53, 54, 58, 60, 61, 62, 63, 65, 66, 69, 70.	2, 6, 11, 21, 22, 23, 25, 26, 27, 31, 33, 34, 35, 38, 39, 46, 47, 49, 50, 52, 53, 54, 56, 57, 60, 61, 67, 68, 70.	1, 3, 4, 6, 9, 10, 12, 13, 14, 19, 20, 23, 24, 25, 26, 27, 38, 39, 41, 43, 49, 50, 52, 53, 54, 60, 61, 62, 65, 66, 67.	5, 16, 17, 18, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 34, 36, 42, 48, 51, 56, 57, 64.
INSTRUMENTS	**FACIAL DEVELOPMENT**	**DENTAL CARIES**	**FULL DENTURES**
5, 8, 16, 17, 18, 19, 21, 22, 24, 25, 26, 27, 28, 29, 30, 31, 40, 42, 46, 48, 50, 51, 56, 57.	2, 6, 10, 25, 26, 27, 33, 34, 35, 36, 46, 47, 49, 50, 56, 57, 67, 70.	11, 19, 20, 25, 26, 27, 31, 33, 34, 35, 56, 57, 67, 69, 70.	5, 11, 15, 16, 17, 18, 25, 26, 27, 32, 38, 39, 65, 66.
SEX	**AGE**	**PERIDENTAL MEMBRANE**	**HAND PRESSURE**
21, 22, 25, 26, 27, 31, 34, 36, 37, 48, 56, 57, 64.	17, 25, 26, 27, 31, 34, 36, 37, 48, 56, 57.	5, 24, 25, 26, 27, 31, 32, 55, 59,	21, 22, 25, 26, 27, 31, 36, 56, 57.
ATTRITION	**METHODS**	**PARTIAL DENTURES**	**HEIGHT**
25, 26, 27, 33, 34, 35, 56, 57, 67.	11, 24, 25, 26, 27, 37, 43.	5, 11, 25, 26, 27, 64, 65, 66.	21, 22, 25, 26, 27, 56, 57.
ERUPTION AND LOSS OF TEETH	**PERIODENTAL DISEASE**	**PYORRHEA**	**GINGIVITIS**
11, 25, 26, 27, 36, 63, 70.	25, 26, 27, 33, 34, 35.	25, 26, 27, 33, 34, 35.	25, 26, 27, 33, 34, 35.
RACE	**RESTORATIONS**	**WEIGHT**	**MEDICO-LEGAL**
25, 26, 27, 33, 34, 35.	11, 25, 26, 27, 32, 69.	25, 26, 27, 56, 57.	25, 26, 27, 46, 47.

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Various methods have been devised and many types of instruments have been constructed to measure the forces exerted by the jaws. These have been described in detail by Brekhus and Armstrong,[8] Haber,[26] and Rowlett.[48] The instrument used in the present investigation is described elsewhere.[7]

A review of the literature on the subject revealed a definite need for a study concerned with the relationship of age and sex to the biting pressure of children. The present study was instituted with the conviction that the establishment of averages for various age groups would be of definite value in future investigations.

TABLE II

MEASUREMENTS FROM FORMER BITING PRESSURE STUDIES

WORKER	REF. NO.	GROUP	(LB.) RANGE	(LB.) AVERAGE	(LB.) MAXIMUM
Arnone	26		6-220	55-66	220
Black	5	Adults	25-275	175	275
Block	26	Adults			550
Burras	26	Adults			500
Dennis	17	A. & Child.	30-85		85
Dietz	26	Adults	66-220		220
Eckerman	26	Adults	45-175		175
Etling	26	Adults	11-135		135
Fenchel	26	Adults			225
Friel	22	Children	15-130		205
Haber	26	Adults	33-264		264
Hauptmeyer	26	Adults	110-275		275
Head	30	Adults	150-340		340
Johnson	31	Children	25-115		115
Klatsky	34	A. & Child.	33-132	88	132
Lancet	36	Children	37-80		80
Licktieg	26	Adults	33-220		220
Mueller, A.	26	Adults	110-297		297
Mueller, M.	26	Adults			220
Patrick	26	Adults			130
Reschofsky	26	Adults	45-55		55
Riechelmann	26	Adults	66-176		176
Rosenthal	26	Adults	88-110		110
Rowlett	48	16 yr.			120
Schulze	26	Adults			45
Taylor	56	Children	10-155		155
Tylman	64	Adults	18-87	45-70	87

In Table II are compiled some of the measurements from former studies on biting pressure. It is given merely to show the wide range in the values reported by different workers. No fair comparison can be made between the values of the various studies due to the difference in: (1) number of cases reported; (2) age; (3) instruments used and (4) classification of cases (bridge, denture, malocclusion, carious, injury, particular tooth, etc.).

The term "biting pressure" as used in this report is construed to mean the maximum pressure the child is capable of exerting when the mandible is closed upon the bite pads of the instrument. It is assumed that most of this pressure is due to the action of the temporal, masseter, internal pterygoid, and buccinator muscles.

Measurements were made on a total of 783 school children (546 males, 237 females), ranging in age from 6 to 17 years. The children comprising the group

TABLE III

FREQUENCY DISTRIBUTION OF BITING PRESSURES

AGE (YR.)	SEX	NO. CASES	BITING PRESSURE (IN LB.)											
			0-19	20-39	40-59	60-79	80-99	100-119	120-139	140-159	160-179	180-199	200-219	220-239
6-7	M	18	1	2	9	6	0	0	0	0	0	0	0	0
	F	6	0	1	3	2	0	0	0	0	0	0	0	0
	B	24	1	3	12	8	0	0	0	0	0	0	0	0
7-8	M	23	1	3	7	10	2	0	0	0	0	0	0	0
	F	16	1	1	7	6	1	0	0	0	0	0	0	0
	B	39	2	4	14	16	3	0	0	0	0	0	0	0
8-9	M	29	0	4	11	12	2	0	0	0	0	0	0	0
	F	29	1	1	12	7	7	0	1	0	0	0	0	0
	B	58	1	5	23	19	9	0	1	0	0	0	0	0
9-10	M	46	0	5	16	15	7	3	0	0	0	0	0	0
	F	31	1	5	7	11	6	1	0	0	0	0	0	0
	B	77	1	10	23	26	13	4	0	0	0	0	0	0
10-11	M	45	0	0	8	18	11	5	2	0	0	1	0	0
	F	34	0	2	7	19	2	4	0	0	0	0	0	0
	B	79	0	2	15	37	13	9	2	0	0	1	0	0
11-12	M	46	0	0	7	13	19	6	1	0	0	0	0	0
	F	41	0	0	10	14	9	7	1	0	0	0	0	0
	B	87	0	0	17	27	28	13	2	0	0	0	0	0
12-13	M	66	0	1	8	22	25	6	3	1	0	0	0	0
	F	41	0	0	5	10	15	7	4	0	0	0	0	0
	B	107	0	1	13	32	40	13	7	1	0	0	0	0
13-14	M	54	0	1	2	13	21	10	5	2	0	0	0	0
	F	20	0	0	4	2	6	5	3	0	0	0	0	0
	B	74	0	1	6	15	27	15	8	2	0	0	0	0
14-15	M	70	0	0	3	10	13	21	13	7	2	1	0	0
	F	14	0	0	1	3	3	4	2	0	0	0	0	1
	B	84	0	0	4	13	16	25	15	7	2	1	0	1
15-16	M	92	0	0	4	10	21	27	13	9	5	1	2	0
	F	4	0	0	0	1	0	2	1	0	0	0	0	0
	B	96	0	0	4	11	21	29	14	9	5	1	2	0
16-17	M	57	0	0	3	3	13	16	12	6	2	1	1	0
	F	1	0	0	0	0	1	0	0	0	0	0	0	0
	B	58	0	0	3	3	14	16	12	6	2	1	1	0

were a representative cross-section of American school children, since they were taken from a number of different schools and orphanages and no effort was made to select the cases studied.

The measurements were made to the closest pound as registered on the instrument. When more than one trial was made, the higher or highest value was taken.

In Table III the frequency distribution of the measurements is given. They have been arranged in yearly groups and according to sex. The scatter or spread of the values increases with age and is similar for males and females.

TABLE IV

MEAN, STANDARD DEVIATION, AND STANDARD ERROR OF THE MEAN OF THE BITING PRESSURE OF CHILDREN OF VARIOUS AGES*†

AGE YR.	BITING PRESSURE (IN LB.)											
	MALE				FEMALE				BOTH			
	NO. CASES	MEAN	S.D.	S.E.	NO. CASES	MEAN	S.D.	S.E.	NO. CASES	MEAN	S.D.	S.E.
6-7	(18)	53	17.2	4.3	(6)	52	10.2	4.2	24	53	15.4	3.2
7-8	23	55	19.0	4.0	(16)	53	18.6	4.6	39	54	18.9	3.0
8-9	29	56	16.3	3.1	29	63	23.3	4.4	58	59	20.1	2.6
9-10	46	61	21.3	3.2	31	59	23.3	4.2	77	60	22.1	2.5
10-11	45	78	25.8	3.8	34	67	19.8	3.3	79	74	23.4	2.6
11-12	46	80	19.4	2.9	41	73	22.5	3.5	87	77	21.0	2.3
12-13	66	80	23.1	2.9	41	84	22.8	3.5	107	81	22.9	2.2
13-14	54	90	24.0	3.4	20	90	26.4	6.0	74	90	24.7	2.9
14-15	70	105	32.0	3.8	(14)	99	42.1	11.4	84	103	32.5	3.5
15-16	92	109	33.8	3.5	(4)	103	21.8	10.9	96	108	33.7	3.5
16-17	57	111	32.0	4.3	(1)	90			58	111	31.9	4.2

*Standard Deviation $= \sqrt{\frac{\text{Sum of the squares of the Observations}}{\text{No. of Cases}} - (\text{Mean of Observation})}$

Standard Error of the Mean $= \frac{\text{Standard Deviation}}{\sqrt{\text{Number of Cases}}} = \text{S.E.}$

†S.D. and S.E. for small samples in parenthesis are of doubtful significance.

In Table IV are compiled the mean, standard deviations, and standard error of the mean for both sex and yearly age groups. The values for biting pressure for both sexes show a gradual increase with age. The total increase in biting pressure over the eleven year period is 58 lb., or slightly over 5 lb. per year. There is no significant difference between the values for males and females. The variability as shown by the standard deviation is considerable, and increases with age. The deviation for the 16-year male group is almost twice that of the 6-year male group. This variability is probably related to variability of skeletal and muscular development.

For the entire group of 783 cases, the values ranged from 0 to 235 lb. and had a mean value of 83 lb.

SUMMARY

1. Relationship and measurements of former works on gnathodynamics were discussed.

2. Biting pressure measurements were made on 783 school children ranging in age from six to seventeen years. There were 546 male and 237 female cases.

The cases were a representative cross-section of American school children. No effort was made to select the cases.

3. The scatter or spread of values as shown by a frequency distribution table increases with age and is similar for males and females.

4. The mean, standard deviation, and standard error of the mean were computed and compiled in table form for the measurements according to sex and age. The mean values increased gradually from year to year. The total increase for the eleven years is 58 lb. or slightly more than 5 lb. per year. There is no significant difference between the values for males and females. The variability as shown by the standard deviation is considerable. The standard deviation increases with age. The range for the individual measurements was 0 to 235 lb. The mean value for the entire group of 783 cases was 83 lb.

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CRITICAL REVIEW OF SOME ORTHODONTIC THEORIES

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THE outstanding literature about the mechanism of the orthodontic movement of teeth and about the resulting histologic changes is almost overwhelming. Nevertheless it is worthwhile to express some thoughts evolved from practice and theoretical considerations.

I do not wish to deal with the abundant literature relating to this subject; I would like to present only one of the very characteristic examples. Ketcham first drew attention to the fact that root resorption during the regulation is sometimes of small degree, but it may be also considerable. This resorption of the roots is one of the most disagreeable complications which occur during orthodontic treatment.

Schwarz[1] in his publication opposes the above-mentioned idea as follows: "If necrosis of tissues begins on the root surfaces to a slight extent, this generally leads to, if at all, a superficial resorption only on the surface of the cementum which shortly develops a new layer. This is undoubtedly shown by thousands of examined histologic sections (Gottlieb, Orbán, etc.). This offers as good a possibility for insertion of the bundles of fibrous tissue of the periodontium as before. Even if the restoration of the cavity of resorption ended leaving pits, there will be a larger inserting surface than before. Its result is a firmer fixation of the tooth in the alveolar bone. Just as a screw sits stronger in wood than a polished nail, so a tooth with pitted scars (through cement resorption) is better anchored in the bone than before. Therefore, little resorptive plaques on the root surface should not be considered a damage.

"The alveolar bone follows this excavation on the root (Fig. 1). Thereby the inserting surface for the newly originated lower bundles will be larger, the position of the tooth in its place stronger than it was."

Schwarz holds that the root's resorption due to the regulation is not a damage, but it is directly advantageous. We can state without a doubt that on this question neither the old opinion nor Schwarz's new one is entirely acceptable.

Let us think of the philosophical sentence, that science is nothing else than the error of today.

I. THE IMPORTANCE OF BLOOD PRESSURE IN THE CAPILLARY SYSTEM OF THE PERICEMENTUM

During orthodontic treatment, as we know it, the main process roughly is that the tooth is moved by mechanical forces. The tooth can theoretically be moved parallel with itself (bodily), but a rotation (around a horizontal axis) too is practically always to be observed. The exact position of the axis of this rotating movement is variable; however, in this paper this point will not be dealt with.

In spite of this we always have to keep in mind that, during the rotation, the parts on both sides of the axis are moving in opposite directions (Fig. 2).

During the following discussion this part of the alveolar bone to which the moving part of the root approaches is to be called the "side of pressure," and that part from which the tooth moves, is the "side of traction."

Well-known histologic research proves that alveolar bone situated in the direction of tooth movement, i.e., on the side of pressure, will be resorbed: On the opposite side of the alveolar bone, namely, on the side of traction, new bone is developing (ossification). If new bone production (ossification, bone growth) and resorption are in balance, the tooth being otherwise undamaged and its position following treatment unchanged for a long period, our correction is ideal.

In certain conditions, not completely cleared up, the resorption of the alveolar bone and the supplementary bone growth are not in balance; consequently, the periodontal area will be wider, and the treated tooth becomes mobile. It may also follow that on the side of pressure, resorption may be observed of lesser or greater degree, not only on the alveolar bone, but also on the root surface. This resorption eventually may be so extensive that the root will be substantially shortened.

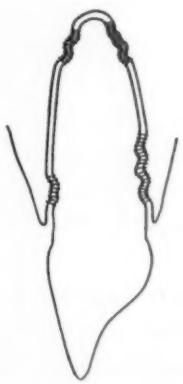

Fig. 1.—Root healed with consecutive pits following resorption on the alveolar margin and the apex. (From Schwarz, Gebissregelung mit Platten, Wien, 1938.)

Schwarz's articles helped to clarify the circumstances of the resorption. He assumes a connection between the histologic changes following the movements of the teeth and the balance of the external force to the capillary blood pressure.

Schwarz's theories were generally accepted. He, himself, alludes to this theory as generally valid in his book previously mentioned (*Gebissregelung mit Platten*, 1938).

Schwarz writes, "We differentiate three degrees of stress acting on the periodontium:

"A. Weak stress, which does not completely block the blood stream at the place of pressure (under 15 to 20 gm. for each square cm. of the pressed surface). This is the most advantageous means of applying a force.

"B. Stress of medium strength blocks the blood stream and after a longer period causes arrested activity of the related tissues. The tissues tolerate this pressure for 8 to 10 hours (duration of the sleeping hours) without damage, especially if this time is followed by chewing without the appliances. This serves as a reviving factor.

"C. Strong stress has a breaking down effect on the soft tissues. After the action of such a stress hemorrhages may appear in the injured tissues."

In 1936 Varga (Budapest)[2] remarked relating to Schwarz's generally accepted dogmata as follows:

"To overcome the hydrostatic pressure external (orthodontic) forces are practically unnecessary. Better said, during the orthodontic tooth movement practically nothing of the applied orthodontic stresses will be consumed for the purpose of overcoming hydrostatic pressure, because hydrostatic pressure will balance itself, acting on each point of the root circumference.

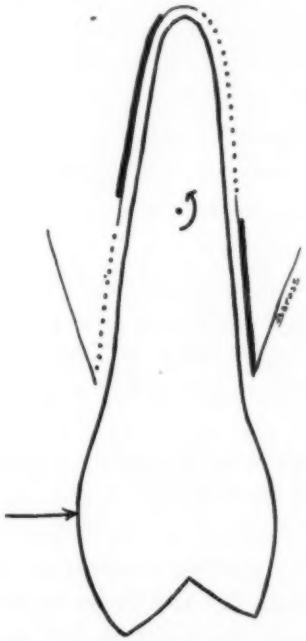

Fig. 2.—The marked point of the axis is arbitrary. (Its real position is another question.) The alveolar wall of the side of pressure is heavily marked; this one on the side of traction is punctuated.

"Therefore, the stress against the hydrostatic pressure during the tooth movements is negligible. The only task that remains for the stress is to overcome the resistance of the tissues against pressure, i.e., traction."

In our opinion Varga's standpoint is acceptable because though the fluid in the alveolar space (in our case the blood) is inside the capillary vessels, still by tooth movements in the paradental space the hydrostatic laws are valid. Beyond doubt the tooth compresses the capillary vessels during its movements only on the side of pressure. This is possible only in case the external stress overcomes the capillary pressure. Schwarz is right, indeed, in saying that the stress in the richly vascularized periodontal tissues necessary to compress the capillary vessels is proportional to the surface and to the blood pressure. Indeed the physiologists, too, measure the capillary pressure

in accordance with this consideration. One must not lose sight of the fact that in the alveolar bone the teeth are surrounded by the capillary system. Consequently on the side opposite the pressure, where the capillaries are not compressed naturally, the capillary system also exists, and in it the blood pressure is equal. If the tooth is moved by external stress, capillary vessels are compressed on one side.

This is possible only in case the external stresses are greater than the multiple of the values of pressure and surface. But one must not fail to consider that the walls of the capillary vessels can be dilated and consequently the capillary vessels are practically moving together with the roots and thus unchanged pressure acts on the root surfaces.

Naturally this moving is only about a few fragments of a millimeter, because the tooth in the periodontal space can perform limited movements only. It should be taken into consideration, that during such little movements the pressure is unchanged on the side of traction. If whatever little external stress is trying to move the tooth (and during the movement to compress the capillary system on the side of pressure) to it is always added the hydrostatic stress existing in the vascular system (of the side of traction).

It is evident that the areas of the pressure and traction surfaces are equal, if the movement of the tooth is practically in vertical direction to the long axis of the tooth.

The blood pressure in the periodontal system of capillary vessels is equal on each side. Naturally the multiples of the pressure and of the surface of both sides (in cases where the direction of the movement is roughly vertical to the longitudinal axis) are equal and are acting accurately in opposite directions.

Thus relatively little stress is enough for the compression causing collapse of the capillary vessels, because the hydrostatic stress manifested on the side of traction will always be added to the external force. Until now we disregarded the stress needed to overcome the suspending forces of the tooth. This is represented in our case by the resistance of the periodontal tissues against deformation. Although the fluid, in our case the blood, is intravascular in the periodontal space and not quite free moving, yet it can be supposed that the hydrostatic laws during the tooth movements in this space are valid.

In spite of the last-mentioned statement (i.e., the hydrostatic laws are valid during tooth movements in the alveolar space) an opinion not quite adequate was accepted for a long time.

As argument for my statements I present the following physical analogies.

The atmospheric pressure is—as generally known—1 kg. on every square centimeter. This pressure is acting on our body with many quintals of stress, and we do not feel that any effort is necessary on our part to counteract it. The idea of atmospheric pressure, nowadays generally accepted, was first demonstrated by the physicists through the famous experiment of the Magdeburg hemispheres.

At the present time it is a well-known fact that for the displacement of a solid body suspended in a liquid or gaseous medium any external stress

component is unnecessary to overcome the hydrostatic pressure, because the circular hydrostatic pressure is balancing itself. Therefore to remove a solid body it is necessary only to overcome the inertia, the friction of the medium, and the eventually acting forces of fixation.

Another analogy: Just under the surface of the sea there is a pressure of approximately one atmosphere; at the depth of ten, twenty, thirty, etc., meters there is a pressure of practically 1+1, 1+2, 1+3, etc., atmospheres. In spite of this fact, to drive a submarine just under the sea surface and in different depths parallel with the water surfaces an equal driving power is needed, and not two, three, or four times greater power. Similarly the musculature of the deep sea fishes is not a hundred times more developed than that of other fishes living just under the surface, although the pressure of the medium in certain depth is a hundred times greater than just under the sea surface.

On the basis of these considerations the following statements can be regarded as probable. The quantitative ratio between the capillary blood pressure and the stresses of the appliances is of no importance, because during the tooth movements no component of external stress is needed to compress the capillary vessels on the side of pressure. (The stress needed to overcome the inertia during the movement of the teeth can be entirely neglected, because of its small mass and velocity.)

According to our view only the resistance of the tissues against the changing of their form is to be overcome in order to displace the tooth in the alveolar space, and thus to evacuate the blood vessels on the side of pressure.

Schwarz totally neglects the volume of this resistance. Corresponding to our view, too, the resistance of the periodontal tissues is insignificant against such little displacement (in a vertical direction to the long axis) which just compresses the vessels. This will be discussed particularly in the following.

II. ARE OUR ORTHODONTIC APPLIANCES ABLE TO TRAUMATICALLY COMPRESS THE PERIODONTAL TISSUES?

In the special literature the opinion is often expressed that the periodontal tissues can be traumatically compressed by the employment of too great a force. Schwarz[1] writes: "Great forces destroy the related soft tissues by crushing."

In the following we intend to examine the effects causing the injuries of the periodontal tissues sometimes observed after orthodontic treatment, relating as well to the soft parts as to the bone or cementum.

Are these injuries (A) primary consequences and results of excessive stresses of the appliance or (B) secondary consequences of disturbances of the blood circulation? Such disturbances can result also from slight stresses.

To settle this question we must consider thoroughly (1) the external forces acting on the teeth, (2) natural fixing of the teeth in their position, and (3) the balance of both.

The movement of the teeth is the result of this balance. It is evident that contusions and ruptures of the surrounding structures are consequences of overburdening of the supporting tissues.

But what is the importance of the factors mentioned under (1) and (2)? According to Schwarz's view accepted so far, chiefly the pressure of the capillary system offers resistance against the movement of the teeth in their periodontal spaces. As he is not mentioning the mechanical resistance of the surrounding structures, we think that he judges its importance as negligible.

In our opinion, as explained in detail, the contrary should be the fact. As external stresses are not needed to overcome the endovascular pressure of the capillaries, consequently only as much stress is necessary for the blocking of the blood circulation in the periodontal space as the resistance of the surrounding structures against any change of their form.

Regardless whether our deduction relating to Schwarz's theory is correct or not, the resistance of the surrounding structures against change in their form is beyond doubt to be overcome, because no movement can exist without this. What are the components of the surrounding structures, one by one, acting in the fixation of the tooth? In first place the most important factors are the bundles of the periodontal fibrous tissue. Their direction is oblique from the limbus toward the root apex. If the tooth is burdened in the direction of the long axis, the bundles stretch and resist the tooth from being pressed into the alveolar socket. Thus the stress burdening the tooth is transformed in traction acting on the alveolar bone.

If the tooth is pressed from a lateral direction, it will be moved in little but not negligible measure. This is possible, by the oblique course of the bundles, which become only less oblique in small degree. (Naturally during this movement the tooth has to emerge from the alveolus in a minor degree.) Thus if the tooth is moving in lateral direction beyond doubt the surrounding structures are pressed on the side against which the tooth is moving.

The soft tissues and the capillary walls have no considerable elastic resistance either on the side of pressure or on the side of traction. (This is correct only within the limit of commencement of the movement, until the blood stream is just blocked.) Furthermore the bundles of fibrous tissues of the side of pressure are practically unable to resist the displacement, being in a state of relaxation, i.e., curved.

Summarized, we can suppose that the surrounding structures of the root do not considerably resist side movements, especially at the beginning of the displacement.

In addition to our statement that the capillary blood pressure does not resist the tooth movement, *we have to accept that also small external stress on the side of pressure could be able to compress the capillary vessels and block the blood stream.*

Naturally this blocking, if protracted, is followed by serious vascular disturbances and consequent necrosis. This necrosis is to be differentiated with difficulty from injuries effected by mechanical compress, and in our opinion the results of both are often confounded one with another.

After this we return to our question: Is there any possibility of causing a mechanical injury by the stress of an orthodontic appliance? A compari-

son may be made between the energy of the orthodontic appliances and of the masticatory stress and the following momentary intra-alveolar movements of both.

The latter is acting physiologically in everyday life and without any consequent damage.

The external force, as well as the stress of the orthodontic appliance, as the masticatory pressure, may act from different directions. The surrounding tissues of the teeth react differently toward forces from different directions, corresponding to their structures.

For simplicity we schematically classify the stresses as they act in the direction of the long axis, or in certain angle to it.

A. *Stresses in the long axis.*—The masticatory stress, acting often in this direction, is of several pounds. The stresses applied in orthodontics are only fractional as compared. The modern active appliances are generally not even able to produce a very small stress, acting in any direction.

It seems probable that orthodontic forces act as a pressure into the alveolus, even bending the fibrous bundles; but the forces are not able to extend the fibrous bundles. Thus they also are not able to block the capillary blood stream pressing the tooth to the alveolar wall.

B. *Stresses at right angles to the long axis.*—The fibrous bundles are oblique in their course, and this gives the possibility of displacement of the tooth, presuming the bundles actually are not bent by a burden acting in the long axis. In such cases the tooth can approach the alveolar wall on the side of pressure, without the tension of the bundles on the side of traction, only their direction will become less oblique. Thus it seems that in cases of lateral movements of small degree the surrounding tissues do not resist considerably. The numerous histologic researches of different authors affirm our theory too. After the use of orthodontic forces applied in the most variable degrees and manners, periodontal processes have been observed, showing that the tooth movements in the alveolar space are followed by signs of resorption, which can be interpreted only as the consequence of the complete block of the capillary blood stream, interrupting the nutrition.

C. *Oblique burdening during mastication.*—The burdening during the mastication is to be considered as a sum of two components: (1) the stress in the long axis and (2) the stress at right angle to the long axis.

The second-mentioned stress generally is less than the first, but after all it is of several pounds. Thus it is many times stronger than the stress of any used orthodontic appliance. But the horizontal component of the masticatory force is not to be compared, without certain restrictions, with the force of the orthodontic appliance acting in the same direction. The circumstances are considerably modified, because during the mastication the fibrous bundles are bent by the longitudinally applied stress, because this is generally greater.

The bent bundles give greater resistance against movements in the lateral direction.

The extension and direction of the tooth movement are determined by several factors: the degree of forces, their direction, the shape of the root,

the direction of the bundles, etc. The result is never to be mathematically compared even in case of arithmetic definition of every factor. But practically in some extreme cases one or another factor can be neglected. Thus the equation will be simplified.

For instance the factor of force acting at right angle to the long axis is substantially more on the front teeth than on the molars.

In some cases, for instance, of forward tipped incisors, there is a possibility that the masticatory stress of several pounds is acting at right angles to the long axis, i.e., in the usual direction of the stress of orthodontic appliances.

Similarly in cases of deep overbite with normal mesiodistal occlusion during lateral and forward movements of the mandible, the pressure often is from the right angle to the long axis of the front teeth. Besides the force in such cases is acting with long arm. In other words the masticatory force is acting in such cases in the same direction as the orthodontic appliance, but it is far greater. Therefore it does not seem as probable that the greatness of applied orthodontic force may damage the periodontal tissues.

It may be supposed that continuous force of the appliance could crush the colloid tissues in greater degree than interrupted forces. But the degree of orthodontic forces is so much less than that of the masticatory forces, that even their longer duration could not justify the observed crushing effect.

Thus I propose to use the expression crushing (Zerquetschung) only very cautiously. After all we think it is regretful, that the very pleasant, and in first view, plausible, theory of Schwarz is not acceptable. Unfortunately we must confess that we are not able to give another theory. The importance of the whole question should be reduced if the complete restitution could be proved.

III. IS THE EFFECT OF THE ORTHODONTIC PLATES "BIOLOGIC"?

The injuries of the periodontium manifested during the regulation and relapses often observed gave the idea to attempt the imitation of natural processes in the methods of treatment. The realization of this idea is the basis of the so-called "biologic" orthodontics.

Different authors have recommended appliances of different kinds emphasizing their biologic effect. Many of them applied the magic word "biologic" in the nomenclature of the appliances too. Today we believe, in our intention toward objective criticism, that the modern fixed appliances (New Angle, Mershon, etc.) are not essentially more "biologic" than the classic Angle arches, only the forms are more practicable.

The modern orthodontic plates differ from the wire appliances in their mode of action. Further I consider more the effect of these plates. In my opinion also the term "biologic" was misused.

I wish to support my apparently bold statements with the following personal experiences.

The main criterion of the biologic orthodontics would be the lack of relapse. This is at least as important a sign as the lack of pain and the integrity of the periodontal tissues, and it is a symptom to be observed exactly.

In my experiences[3] I observed that the arch of teeth often become extended in the region of the premolars and the molars during the application

of simple plates, without any widening appliance. The observation of such cases has shown that this extension was not always permanent. In the cited paper I alluded to this fact, intended not to occupy myself with the possibility of relapse.

The plates were applied in the subsequent manner. In several cases the plane of the rim was approximately parallel to the masticatory surfaces; in other cases it expressively sloped downward. In some cases the plates were continuously worn, in other cases only during certain parts of the day and during the night, and again in other cases during the night only. On some plates there was applied a wire loop, as on the Hawley retainer; other plates were fixed only by adhesion without wire. The plates were so constructed that initially the gap between the molars was 1 mm. After this gap disappeared and the molars were in contact, another plate of higher rim was applied. This process was repeated generally three or four times. As mentioned, the widening effect was greater in the premolar region than in the molar region.

We do not know the mechanism of this effect. There is a possibility it is a consequence of sinking of the plate, caused by the resiliency of the mucous membranes. Perhaps this explains why the extension was always greater in the region of the premolars. It can be supposed too that tiny movements of the plate are causing the extension. This supposition is affirmed by cases, where only one or two plates were used, and without measurable sinking, the extension was considerable.

It has often occurred that the child did not wear the appliance during some days for different reasons. We have had the experience in some cases that after such intervals the appliance seemed too large, and it was impossible to put it into its former position (even though it fit previously). Thus the widening effect of the former plates disappeared too. This determined the relapse beyond doubt.

We tried unsuccessfully to find some connection as between the design of plates and their mentioned expanding effect, as between the relapse and the design of the plates. I believe it can be supposed that the effect of our simple rubber plates is more "biologic" than the effect of plates with auxiliary springs and with other widening appliances, for instance, screws. This can be said because these simple plates press the teeth with intermittent and considerably less stress than the plates with auxiliary appliances. (Some present-day authors suppose that intermittent stresses are more adequate for "biologic" requirements.) I consider it correct to emphasize the incorrect use of the term "biologic," etc., because we have often seen relapse after the use of simple plates.

Schwarz in his book occupies himself with the use of his plates provided with auxiliary widening appliances. He gives practical advice to prevent relapse. This proves beyond doubt that he also admits the possibility of relapse. This standpoint of Schwarz is more correct practically as well as theoretically, than the opinion of others, who recommend methods called "biologic," but which after use bring about consequences that often appear contrary to the "biologic" idea.

SUMMARY

1. The pressure in the periodontal capillary vessels (endovascular pressure) acts on the tooth with equal stress from each side similar to hydrostatic pressure. These stresses acting circularly from opposite directions equalize each other during the tooth movements as well as during the motionless state of the teeth. Therefore in our opinion the external moving stress has to overcome only the resistance of the surrounding structures against the tooth movements. Consecutively we cannot speak about relation of the degrees of the two forces: the force of the appliance and the resistance of the capillary hydrostatic pressure acting against the tooth movements, considering the value of the second to be zero.

After this naturally we cannot take in relation the histobiologic changes to the balance of the above-mentioned forces.

2. The tooth is often exposed to masticatory stresses acting from equal distances as our orthodontic appliances. These masticatory stresses do not cause trauma in the periodontium.

It should be considered that the size of the still obliquely acting masticatory stress is multiple of the stress of active orthodontic appliance. Therefore a mechanical crushing of the periodontal tissues through our usually applied orthodontic appliances is not probable.

3. Relapses occur also after orthodontic treatment with plates. In our experiences after the use of simple plates without any widening auxiliary appliance, the dental arch has often been widened. But in such cases, too, sometimes the relapses are manifesting themselves, the lateral teeth remigrate. It is probable that relapse follows rather the use of plates with active auxiliary widening appliance. Thus the "biologic" action of the mentioned appliances is very doubtful, in spite of the emphasized term "biologic."

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IV Muzeum-körut 5

THE AMERICAN BOARD OF ORTHODONTICS

HARRY E. KELSEY, D.D.S., BALTIMORE, MD.

THE Directors of the American Board of Orthodontics appreciate the invitation of this society to present a brief commentary upon its organization, its accomplishments, and its future objectives, and as President of the Board, I shall endeavor to do this.

For some time past we have felt that the American Board, and what it stands for, should be better known both to the members of the orthodontic specialty, and, even more particularly, to the members of the dental profession generally. There has been a number of instances in which our attention has been called to the fact that a large proportion of the dental profession was not aware of the existence of the Board, although most of them are aware of the fact that the specialty of orthodontics exists and has been for many years well organized with national as well as regional societies which have had a stimulating effect upon the specialty and the profession as a whole. A case in point is the experience of a member of this society, Dr. M. Alden Weingart. After making an excellent radio talk to the general public on the possibilities held out by orthodontics for the improvement in the functioning of the teeth and appearance of the face, during which he made some explanatory allusions to the American Board of Orthodontics and its objectives, he was surprised to learn not only how many laymen, but also how many dentists were unaware of the existence of the Board, and he very rightly thinks that this should be corrected, so that dentists would have the benefit of knowing what orthodontists have been accredited by the Board. Of course, in referring patients they may be able to select competent men in their own neighborhood who might or might not hold the certificate of the Board, but they could do so much more intelligently in referring patients in other parts of the country, if they had the information referred to.

To Dr. Albert H. Ketcham really belongs the credit for starting the movement which resulted in the formation of the American Board. Without his untiring efforts, the movement would probably have died out as ideas of a similar nature had done previously. He wisely sought the aid and experience of the American Board of Oto-Laryngology (the first board of this kind), and I wish here again to acknowledge our debt to them for their invaluable assistance. We were able to pattern our Board after theirs, which had attained a high state of efficiency as the result of years of experience during which errors could be corrected and methods of sound administrative procedure be proved and adopted.

As you are aware, the number of certifying boards for the various specialties of medicine has been greatly increased in the last few years, and many hospitals today limit appointments to those men who have been certified by their boards.

Read before the New York Society of Orthodontists, Nov. 13, 1939, New York City.

Two other specialties of dentistry have this past year established, or are establishing, certifying boards, one of them the American Academy of Periodontology, and the other the American Society of Exodontists and Oral Surgeons. The movement has even been carried so far as to organize an American Dental Association Advisory Board to coordinate the activities of the certifying boards which now exist or may be organized in the future. Such a coordinating board, composed of representatives from the various medical specialty certifying boards, has been in operation for some time.

It is now about ten years since the American Board of Orthodontics was formed. In the beginning, a number of men who were outstanding contributors to orthodontic literature and were nationally known for their excellence in operative procedure, and who had been in practice for fifteen years or more, were certified on their record. This was in line with a classification adopted and still in effect, and those men who were certified on their record, or eligible to be so certified, comprise class one. Those who have been in practice ten to fifteen years comprise class two. Those who have been in practice from five to ten years comprise class three. It must not be supposed that the Board has ever made a habit of certifying men who have been in practice fifteen years or more simply because of that one qualification. Such a man, who had not contributed to the literature or to society programs, who had, in other words, given no evidence of proficiency by which he could be judged, might be asked for as much material in the way of theses and case reports as would be asked of other men who had been in practice from only five to ten years. As a rule, men who have been in practice from ten to fifteen years are not asked to present as much material as are those who have been in practice from five to ten years only. Thus it will be seen that a man's record of accomplishment, his interest in his work and in his professional organizations, and his general record for high ethical conduct all have a bearing upon the question of requirements. The Board welcomes applications from men who are sufficiently interested in what the certificate stands for to be willing to take the time and trouble to make a good presentation. There are not likely to be very many certificates issued in the future simply on a man's record. It would seem there is good reason for this, since the Board feels that a man whose record at the end of fifteen years' practice would entitle him to certification should have made application long before, due to the fact that the Board has already been in operation for more than ten years; if he did not value the certificate highly enough to do so, the Board feels that he should demonstrate his supposed efficiency after fifteen years' practice as well as before. Perhaps the thing the Board takes most pride in is the fact that of the men who apply, a very large percentage are among the outstanding ones in their communities.

There are more than 600 orthodontists in this country and abroad, and up to the present time 178 have been certified after satisfactorily complying with the requirements of the Board by giving evidence of high standards of practice and ethical conduct toward their patients and also toward other members of the profession and by submitting acceptable case reports and theses on subjects suggested by the Board. The Board is fully aware that there are many others who are quite competent to meet its requirements as they have

been built up during the more than ten years of its existence, and the applications of such men are always welcomed by the Board. One of the most important phases of application is the securing of adequate endorsement. The Board cannot possibly have knowledge as to the fitness of all applicants and would not wish to take the responsibility of endorsing applications even in cases where they might be well assured through intimate personal acquaintance that the applicants possess the high ethical, moral, and professional qualifications which are, of course, fundamental in any application. Nor does the Board feel that the endorsement of an applicant by some friend or friends, however outstanding, in a section remote from the applicant's own address, would be acceptable without equally adequate endorsement by confreres in his own location.

During the first few years quite a good many applications were received and accepted, after which the applicant for one reason or another failed to prepare and present the material desired by the Board (in the way of theses and case reports) at its following meeting, nor indeed thereafter in some instances for three or four years. During the last two or three years, to obviate any unfairness, the Board has granted extensions in many cases so as not to work a hardship or be unfair to anyone who might not have been fully acquainted with its working details. The Board now feels that applications should be followed up by meeting its requirements within three years, failing which, the Board will feel justified in requiring a new application.

The Board has noted with much satisfaction the growing appreciation of the apparent value of its work and desires to thank the various orthodontic societies and the profession at large for the increasingly cordial support which is being given to it.

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MEDIAN ANTERIOR MAXILLARY CYSTS

REPORT OF A CASE

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THE origin and management of cysts of both the mandible and maxilla have long engaged the attention of those interested in pathologic conditions of the jaws. Cysts of the maxillary bones were recognized and described as early as the seventeenth century; moreover, their connection with the teeth was readily established. The erroneous belief that all cysts of the jaws originated from the dental system persisted until a keener appreciation of the anatomic normal and the employment of better diagnostic means had cast light upon the existence of certain nondental cysts.

Until the time when this newer knowledge regarding the classification of cysts of the jaws became known, it was generally assumed that but three types of lesions existed. The first and most common was the radicular cyst which develops about the apex of a devitalized tooth, very frequently the maxillary lateral incisor. The follicular or dentigerous cyst was found associated with an unerupted tooth, the crown of which is enveloped within the membranous cavity. The third and most infrequent type was the adamantinoma which is usually multilocular in nature; because it possesses the tendency to recur, it is considered a locally malignant neoplasm. The site of onset is more often the mandible than the maxilla, the ramus having a predilection for this particular variety.

It is considered axiomatic that a cystic membrane is composed of fibrous tissue lined with epithelium, the latter an essential constituent. The derivation of this epithelium has been the cause of much speculation. The peridental membrane, the enamel organ, and the dental lamina have been considered as probable sources. Black was of the opinion that the epithelial cells which he found in his histologic studies of the peridental membrane, were the origin of the cystic lining. The oral mucous membrane gives rise to the dental lamina which dips down to form the enamel organ and matrix of the teeth, both deciduous and permanent.[1] A further requisite for cyst formation is the presence of some irritating agent to stimulate proliferation of the epithelial cells. Infection and inflammation appear to be the activating factors.

In addition to these common lesions several traumatic bone cysts have been reported.[2] In these cases, although the root ends are usually found to be denuded of bone, pulp testing has proved the teeth vital. No evidence has ever been produced indicating that the teeth are the causation. Since the existence of an epithelial membrane has been open to doubt, it remains a moot question whether such lesions are in reality true cysts.

In 1914, Meyer[3] reported finding a large cyst in the median plane of the maxilla in a dissecting room cadaver. In 1920, Congdon[4] reported a similar case. These cysts were found in bodies past middle age and were noted because the dissection involved the making of median sagittal sections. Schroff, in 1930, reported four cases all of which produced symptoms of pain and swelling. These newly recognized cysts, which have no connection with the teeth or contiguous dental structures, develop in the incisive canal at the palatal orifice. They have been termed anterior palatine or, as designated by Meyer, median anterior maxillary cysts. Both Kronfeld and Thoma have previously described them. A brief anatomic review of this region is probably not amiss as a basis for acquiring acquaintancy with these lesions.

ANATOMY

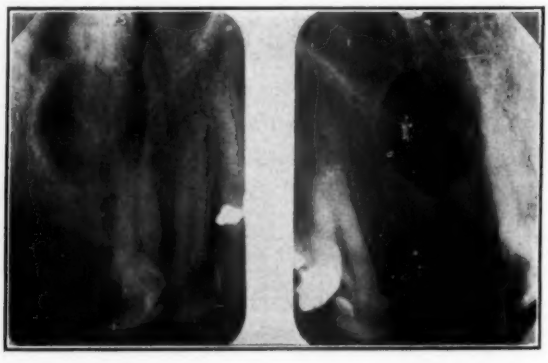
The articulation of the two maxillae forms a funnel-shaped opening, the incisive opening, which is located immediately behind the incisor teeth. In this foramen the orifices of two lateral canals are visible; they are named the incisive canals or the foramina of Stenson; through each of them passes the terminal branch of the descending palatine artery and the nasopalatine nerve. Occasionally, two additional canals are present in the middle line; they are termed the foramina of Scarpa, and when present transmit the nasopalatine nerves, the left passing through the anterior, and the right through the posterior canal.[5]

GENERAL CONSIDERATIONS

It is of interest to note that the existence of these nondental cysts has been but comparatively recently drawn to the attention of the profession, yet statistical studies as to their incidence have revealed a surprisingly high frequency of occurrence. Meyer found in a dissection of 600 cadavers an incidence of one in sixty-six. A roentgenographic study made at the Mayo Clinic disclosed the presence of approximately one in every hundred patients. How is this great frequency to be considered compatible with the very pronounced infrequency of discovery? To speculate that the human race had lately become heir to a new lesion would appear as fallacious reasoning. Rather would it seem that these cysts have long existed but because of the absence of symptoms, both subjective and objective, their presence has been overlooked. If this is true, then it might be very logical to inquire why so many cases have escaped detection in view of the thousands of x-rays taken of this particular area. It is obvious that the reason must be the failure to distinguish carefully the pathologic from the normal.

The treatment of cysts in general is based upon the natural tendency of nature to regenerate bony structure when the pressure of the contents of the cavity is removed. Whether the closed operation, or the open or Partsch method

is employed is most important, although not pertinent to the subject of this paper. The treatment of median anterior maxillary cysts is based upon the degree of clinical importance attached to their continued existence. It is well known that cysts of the jaws may be either sterile or infected. Surgical intervention is, therefore, indicated in the former type to prevent encroachment, and in some cases partial obliteration, of such structures as the antrum and nose. In the infected cyst the elimination of the infection is the primary object of treatment. From the current literature pertaining to median anterior maxillary cysts, there is gathered the impression that these cysts do not have the tendency to attain large proportions as often as do other types. This may be ascribable to the greater possibility of drainage since communication exists with both the nasal and oral cavities. Thus, treatment is more often indicated when infection has developed with the usual associated symptoms of pain and swelling. Pressure of the cyst upon the nasopalatine nerve and vessels is quite possible and may probably account for the obscure pains occasionally experienced in the premaxillary region. Ease of access is the essential factor in determining the surgical approach. If teeth are present their vitality in no way should be endangered. In most cases the elevation of a palatal flap is the method of choice. In the case here reported, intervention was obtained by raising the labial soft tissue and penetrating the outer plate of the maxilla.



A. *B.*

Fig. 1*A* and *B*.—Two views of a cyst of the incisive canal.

CASE REPORT

The patient was a 50-year-old well-developed woman. She complained of swelling and discomfort in the anterior maxillary region occurring intermittently during the previous year. Clinical examination revealed a slight puffiness in the maxillary incisor area which was tender on palpation. An x-ray (Fig. 1 *A* and *B*) showed a large circumscribed radiolucent area corresponding to the incisive foramen region. A diagnosis of median anterior maxillary cyst was made.

Access to the region was gained through the labial aspect of the maxilla. The cavity was found to be filled with a thick yellowish pus which, with the lining membrane, was removed. Slight hemorrhage from the nasopalatine vessels occurred. The flap was replaced and sutured.

The microscopic study revealed dense fibrous tissue with localized areas heavily infiltrated with round cells. The remnants of the lining membrane

were composed of ciliated epithelium. In view of this fact, the suggestion is made that the origin of the cyst was from respiratory epithelium. Recovery was uneventful.

SUMMARY

Recently attention has been drawn to the occurrence of cysts within the incisive canal of the maxilla. These lesions of nondental origin, developing in an area of normal anatomic radiolucency, have been variously designated anterior palatine and median anterior maxillary cysts. Studies of their frequency have revealed a high incidence. The case reported in this paper was of a middle-aged woman in whom symptoms of swelling and discomfort occurred. The knowledge that such cysts do exist and that they may be a source of infection is sufficient reason for more accurately diagnosing conditions of the premaxillary region.

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THE WARREN CHAMBERS

THE MANAGEMENT OF VARIOUS TYPES OF DENTAL SURGICAL CASES

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THE purpose of this paper is to describe the methods of performing certain surgical procedures in the manner which seems best suited to each. This will necessarily limit the discussion of detailed technique for each procedure. It is my hope that the examples* used will supplant a lengthy discourse on the technical aspects of removing teeth.

The factors to be considered first in the management of dental extractions are, of course, the local and general symptoms existing preoperatively. Most patients who present themselves for extractions are fortunately well able to withstand an ordinary extraction. Although dentists do not attempt the general examination of patients, considerable information may be obtained from their appearance and by asking a few questions. The age is of significance. All patients over forty years, particularly men, should be looked upon as possible poor risks, and if the procedure to be carried out is severe, should undergo a general examination before surgery is attempted. The obese patient, as well as the heavy-set, thick-necked, florid-faced type, is a poor risk, especially if one is considering the use of a general anesthetic. If a patient has been rejected as an applicant for life insurance, he should certainly have a general examination before surgery.

It has been said that the number of teeth which can be removed at once depends on the patient's general health. In my opinion this factor depends almost entirely on the skill and judgment of the operator. More reaction can be produced by the simple extraction of one or two loose teeth, if no satisfactory débridement and removal of granulations are done, than by a complete alveolectomy properly carried out. Subjecting a sick patient to more than three or four visits, even for removal of all teeth, is wholly unnecessary. Hospitalization may be advisable, however, if the procedures to be done are very severe, or if the patient is quite debilitated. Cooperation with the patient's physician is desirable, and in a measure he shares the responsibility.

Any of the excellent anesthetics in use today may be selected for the removal of teeth. Their use depends entirely upon the familiarity of the operator with them and the requirements of each case. Local anesthesia in most hands is certainly the best. However, it is my observation, provided the surgery is done with equal care and attention to detail, that most types of dental wounds heal more quickly and comfortably if done under general anesthesia. The severity of the procedure, condition of the patient generally, and the local symptoms govern the choice. I believe that any debilitated patient is a better risk when a proper local anesthetic is used. Most general surgeons

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*A motion picture was used to illustrate the technique of several operations when the paper was presented at the Mid-Continent Dental Congress, St. Louis, Mo., October, 1939.

now subscribe to this principle. However, occasionally it is absolutely necessary to do a severe case under a general anesthetic in order to relieve pain or to establish drainage for an abscess. I have had very little success with nerve block when used to remove an acutely sore tooth. There is also the extremely apprehensive patient who should be managed by use of general anesthesia. If the case requires longer than ten minutes, the patient should be hospitalized.

In our practice the most frequently used general anesthesia is nitrous oxide and oxygen, with the addition sometimes of a little cyclopropane if the patient is hard to keep at a good level of anesthesia. Next in order of frequency is pentothal. Ether is still the most reliable agent where a long, profound, and safe anesthetic is required.

Very few dentists operate with the patient in a supine position. I can see no real disadvantage to this and after one becomes used to it he finds that his cases go much better, with no interference from the patient's attempts to expectorate. This, of course, requires the use of sponges and an aspirator. Effective use of a good aspirator is, in my opinion, one of the important factors in producing good postoperative results. The field can be isolated satisfactorily with sterile sponges which also serve to prevent aspiration of foreign material by the patient. There is a tendency for both patients and some dentists to joke about the use of an operating table for the removal of teeth. One must be good natured about this and most patients will subscribe to the idea when they compare their comfort to previous experiences. If there is room in the office for two chairs it seems to me that one should be either a table or a type of chair which can be converted into a table.

One should be as careful in the toilet of the field of operation after removal of teeth as in the preparation of a cavity for a filling. Loose pieces of process delay healing and are annoying to the patient. If there is any question as to the presence of a fractured process, it is best to remove it rather than chance postoperative disturbance.

Instructions to the patient on dismissal are important and should be given with a definite attitude. He should be told not to use a mouth wash until the following day. Cold applications to the face for several hours following dental surgery will tend to abate much of the swelling associated with the procedure. Some provision should be made for controlling pain. It is customary in our practice to give the patient a prescription for a narcotic to be used if lesser analgesics fail.

A definite appointment should be made to see the patient on the third or fourth postoperative day, and he should be instructed to telephone if anything seems to be wrong with his recovery. If postoperative roentgenograms have not been made immediately following the operation, they should be made at this time. If the patient is not progressing satisfactorily, some consideration should be given to his fluid intake and elimination. Rest is an important measure in treatment at this time, and either a hypnotic or opiate should be prescribed if necessary.

In the control of postoperative pain it is essential to find the cause. It may be due to the presence of spicules or trauma, or it may be pain in a

normal wound or in the so-called dry socket in which the clot has failed to begin healing. The local application of medicaments may be necessary to give relief. The wounds should be thoroughly washed and all sloughing tissue and clot removed. It may be necessary to give a short nitrous oxide anesthetic to do this.

The control of hemorrhage following dental surgery is a fairly simple matter if the surgery has been properly carried out. Rarely will a persistent hemorrhage occur when all granulation tissue has been removed and the gingivae trimmed to a clean margin. If bleeding does occur it can routinely be stopped simply by laying a wet gauze sponge across the ridge and having the patient apply pressure for fifteen or twenty minutes. Epinephrine chloride may also be used to saturate the sponge. If these measures are unsuccessful, it is a great time-saver to block the area with novocain and reduce the alveolar margins sufficiently to make flaps and suture them together or suture a cotton roll in place. It is quite likely that oxalic acid used intravenously will be commonly used in these cases if the favorable reports about it prove to be borne out by experience.

Many perforations of the maxillary sinus occur during removal of the maxillary premolar and molar teeth. They usually heal without difficulty if let alone. Generally speaking, it is not good practice to wash the sinus with water through this opening. The sinus is lined with ciliated columnar epithelium which changes to a squamous type when a fistula is allowed to persist. Closure of these openings as soon as possible is indicated. Cooperation with an otolaryngologist may be required to treat the case properly.

Many complications can occur following dental surgery. It is not possible to avoid all of them. Anyone who attempts to operate on the more severe cases will encounter occasional difficulties calling for skill and judgment. The best prevention is the exercise of careful surgical precautions under the most aseptic conditions.

BLOOD DYSCRASIAS

Their Oral Manifestations

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ALL cases of blood dyscrasias do not show or give a sufficient number of symptoms that they may be dwelt upon, so I have taken the liberty of selecting only those dyscrasias that do show some mouth lesions.

Almost all blood dyscrasias may at one time or another be associated with an anemia. Anemia may be defined as a quantitative or qualitative deficiency of the red blood cells or hemoglobin.

Anemias not due to a previous recognized disease are termed primary anemias. The secondary group are due to a definite known disease or hemorrhage.

Anemias are due to:

1. Deficiency of some intrinsic or extrinsic substance, essential to the formation of red cells and hemoglobin.
2. Defective blood formation, due to injury of the blood making organs, especially the bone marrow.
3. Disintegration or hemolysis of the blood caused by exogenous or endogenous toxins.
4. Acute or chronic blood loss.

PRIMARY ANEMIA

This anemia is very common and many suffer from the condition without being aware of it themselves, or its being recognized by those from whom they seek advice for other complaints or for that feeling of weakness.

In its mildest form the patient is not very vigorous. He is usually pale of face. On depressing the lower eyelid the inner surface presents a pale or mottled appearance. The mucous membrane of the lips is also usually paler than normal.

The patient "tires" easily and never feels up to par. He is subject to colds and has a lowered resistance to illnesses. He suffers from "bad circulation" and always has cold extremities. The hands and feet are always cold and perhaps moist and clammy. In the winter he feels the cold intensely. His condition is due to causes which are themselves the result of anemia. First, the heart is none too vigorous because it is supplied by anemic blood, and therefore, there is not enough force to drive the blood to the extremities, and secondly, the blood is deficient in oxygen and is lacking in heat producing properties. This can be proved by the fact that the administration of an iron mixture will remove the chilblains.

PRIMARY PERNICIOUS ANEMIA
(Addisonian Anemia)

The principal oral manifestations of this disease are really the pathognomonic symptoms of this anemia. A Moeller's glossitis or Hunter's tongue

is present in about 75 per cent of these cases. The patient experiences a sore, painful tongue. There is usually a denuded area on the side of the tongue. There is a burning sensation of the tongue which is aggravated by thermal changes or when in contact with highly seasoned foods. The pain varies from being mild to the degree where eating is made unbearable. The pain is located chiefly to the anterior two-thirds and mainly the tip of the tongue. It is due to the atrophy of the epithelium, thus leaving the nerve endings covered by a thin layer of epidermis.

Another oral symptom is the color change of the mucous membrane. The mucous membrane is usually quite pale. The soft palate takes on a greenish-yellow tint. Hemorrhagic petechiae may be present.

Generally we find a gastrointestinal disturbance, a lack of hydrochloric acid in the stomach, loss of appetite, formation of gas, and constipation or diarrhea.

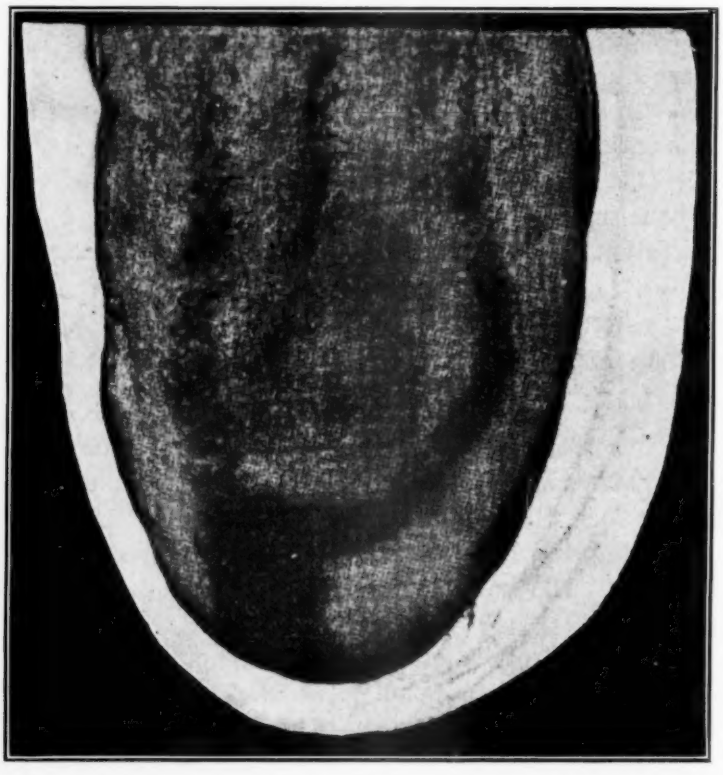

Fig. 1.—Typical case of Moeller's glossitis; epithelium appears to be normal but the patients at times complain of painful areas.

The color changes of the mucous membrane and the Hunter's tongue are pathognomonic symptoms of primary pernicious anemia.

This smooth denuded tongue must be differentiated from the smooth tongue that occurs as a result of senile atrophy or the bald tongue of pellagra and syphilis. In pellagra the denuded tongue is dry and swollen. In syphilis the tongue smoothness is accompanied by sclerosing glossitis.

Blood Picture.—The blood picture of primary pernicious anemia shows a great diminution of the red blood cells (often as low as 1,000,000). The hemoglobin is reduced, but the color index is above one.

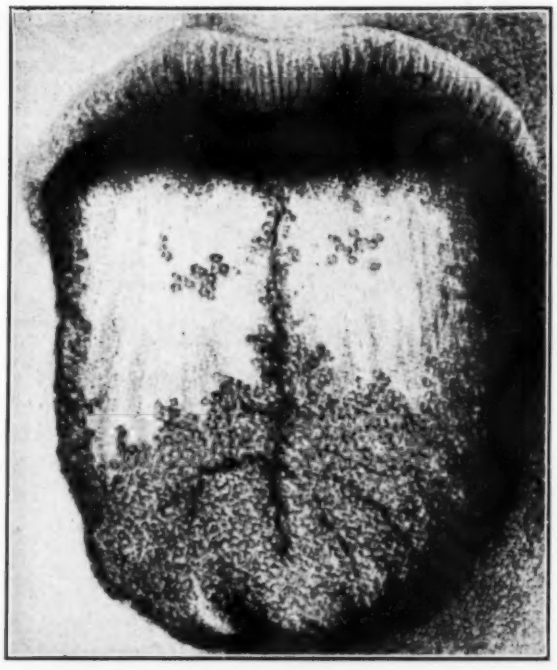

Fig. 2.—Hunter's glossitis. Similar clinical picture as found in Moeller's glossitis.

Fig. 3.—Photograph of the tongue showing two large denuded smooth areas.

Treatment.—Treatment of primary pernicious anemia calls for the administration of liver extract and liver.

CHLOROSIS

Chlorosis is rarely seen now. It is an iron deficiency anemia. The patient usually has a greenish-yellow pallor.

In the mouth we find the mucous membrane pale, gingivitis and periodontoclasia present. There are a great number of cavities in the teeth and a definite softening of the dentine.

Blood Picture.—There is a marked decrease of the hemoglobin accompanied by a slight decrease in the number of the red blood cells with resultant color index below one. Leucocytic count is normal or slightly diminished.

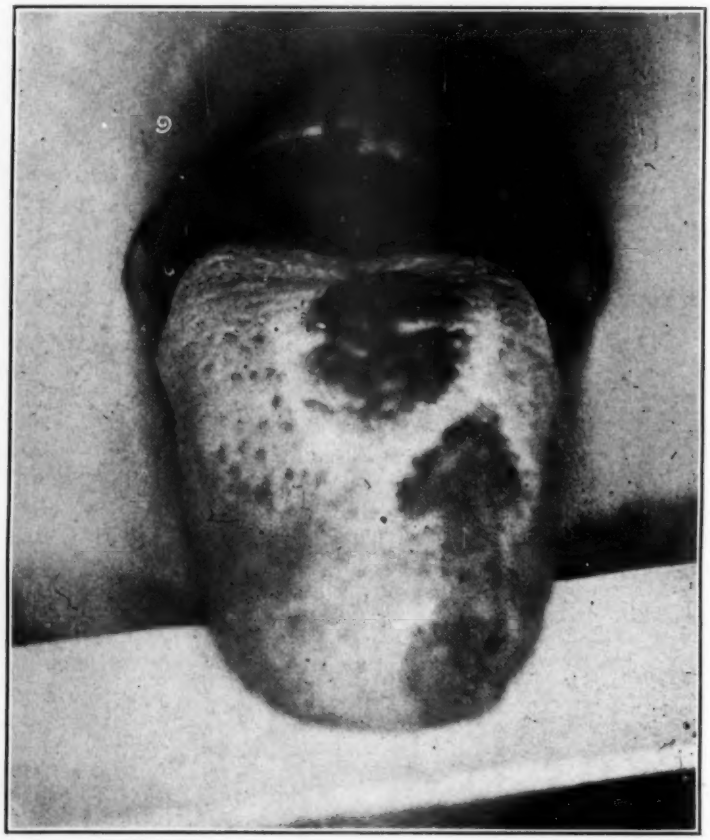

Fig. 4.—Geographic tongue. Characterized by a chronic desquamation of the epithelial surface of the tongue. Occasionally red smooth areas are noticed. There are rarely any subjective symptoms.

SECONDARY ANEMIA

Secondary anemia is due to hemorrhage or to a definitely known disease or deficiency. The pathologic causes may be:

1. Poor nutrition
2. Acute infectious disease in typhoid
3. Chronic infectious disease: tuberculosis, syphilis
4. Chronic exhaustive disease: chronic nephritis

5. Chronic poisoning: lead, arsenic
6. Animal parasites: malaria
7. Malignancies
8. Hemorrhage

Symptoms.—The oral symptoms are: pallor of the lips, tongue, and mucous membrane; gingivitis with marginal bleeding. Dental infection may be a factor in producing the anemia or increasing its severity.

Blood Picture.—Hemoglobin is diminished according to the degree of anemia. The red blood cells are normal in mild cases and diminished in all others. The color index is normal or slightly diminished. Leucocytosis is common.

Treatment.—Treat the cause as prescribed and treat the anemia depending on the severity of the condition. In mild cases, iron alone may be enough. At times transfusions are necessary, and frequently dietary regulation is instituted. Liver may be used also. However, the prognosis depends upon the condition which causes the anemia.

Fig. 5.—Hypertrophic gingivitis. Typical chronic proliferation of gum tissue. Gum is polyplike in character; condition is painless and may be considered an abnormal overgrowth.

Hemorrhage.—In secondary anemias due to hemorrhage there is an acute or chronic loss of blood from the body or into the body cavities. The hemorrhage may be from:

1. Trauma: i.e., rupture of spleen, kidney, or liver following external violence
2. Following childbirth
3. Gastrointestinal hemorrhage following typhoid ulcer, neoplasm of the gastrointestinal tract, or gastric ulcer, etc.
4. Operative or postoperative hemorrhage
5. Extrauterine pregnancy with rupture of sac

Treatment.—Acute: Remove the cause; transfuse.

Chronic: Diet and iron medication to be prescribed. Stop hemorrhage locally.

APLASTIC ANEMIA

Aplastic anemia is a disease of obscure etiology characterized by a deficiency or absence of blood regeneration followed usually by a fatal outcome.

Some of the causes of this disease are: chemical poisons, excessive exposure to x-rays and radium, and the end results of severe anemias.

Blood Picture.—The disease is very progressive. The red blood cells decrease first, but the color index is about one. There is a gradual decrease in white blood cells (at first mostly granulocytes). The next to disappear are the blood platelets and then in the late stages, the lymphocytes. There is a complete aplasia of the bone marrow.

Symptoms.—The symptoms are similar to other anemias. There is a great tendency to spontaneous hemorrhages. There are petechiae on the skin, the mucous membrane, and gums. Prognosis is unfavorable.

Treatment.—Treatment involves transfusions and putting the patient on a high caloric and vitamin diet or injection of pentanucleotides.

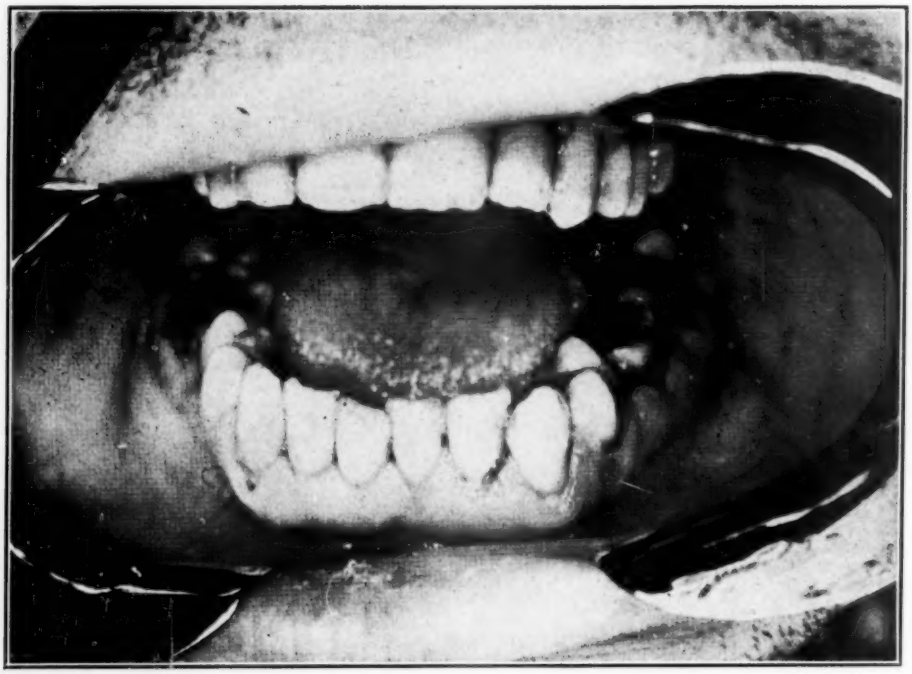

Fig. 6.—Aplastic anemia. Bleeding, spongy gums in oral cavity of patient suffering from aplastic anemia.

POLYCYTHEMIA

Polycythemia is a disease of the blood, characterized by an increase in the red blood count above the normal level. Polycythemia may occur:

1. In individuals living at high altitudes
2. In poisoning with carbon monoxide
3. In cardiac disease of congenital type
4. In chronic bronchitis
5. In long continued chronic passive congestion
6. It may also be primary, i.e., polycythemia vera

In the oral cavity we notice the bleeding of the gums. This condition occurs as a concomitant symptom in many local disturbances of the mouth, and therefore no great significance can be given to this particular symptom.

In severe types the skin and mucosa are cyanosed and appear a purplish red. There is an enlargement of the spleen. Nervous symptoms appear, similar to those in a brain tumor.

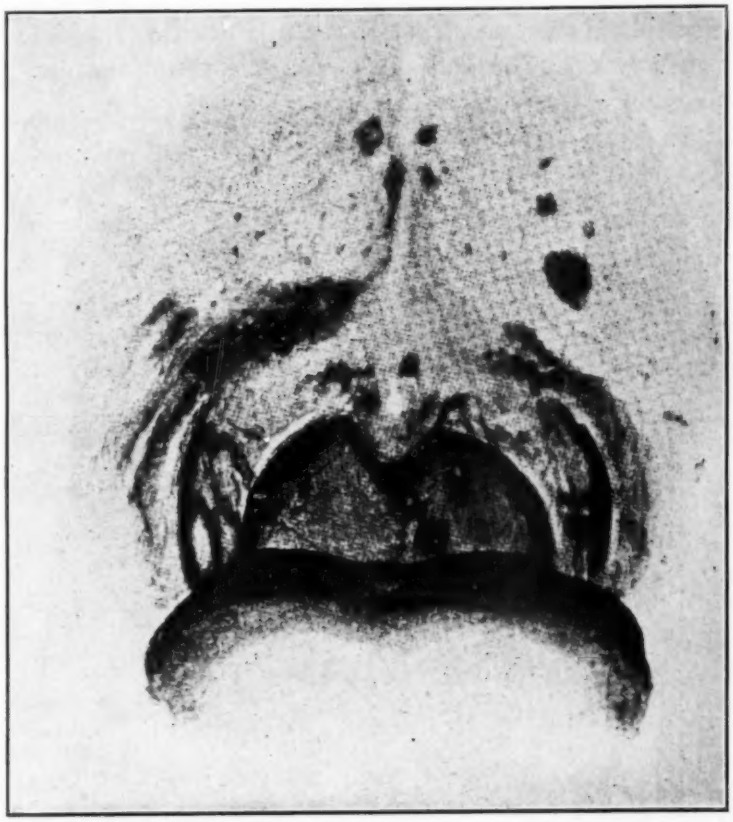

Fig. 7.—Werlhof's disease. Typical hemorrhages of the mucous membrane of a case of purpura.

Blood Picture.—Some authors feel that the disease results from an anoxemia of the bone marrow because they have found that the capillaries of the bone marrow have been partially fibrosed. The blood picture of this disease shows a marked increase of the red blood cells (as high as 8,000,000) and the hemoglobin (140 to 150 per cent). The color index is low. Rosenthal believes that the bleeding is due to thrombi formed by the numerous red blood corpuscles in the terminal ends of the blood vessels. These patients are poor surgical risks due to their susceptibility to thrombosis and infection.

LEUCEMIA

The term leucemia has been associated with blood disturbances characterized by an increase in the leucocytes of the blood. It was first described by Hughes Bennett in 1845 as a disease in which there is an increase in the "colorless corpuscles." At about the same time Rudolf Virchow divided pa-

tients with leucemia into two groups, depending on whether lymphatic enlargement or splenomegalia predominated. Leucemia today is usually divided into three groups, lymphatic, myelogenous, and monocytic. Leucemia may be either acute or chronic.

LYMPHATIC LEUCEMIA

Lymphatic leucemia, the etiology of which is unknown, is characterized by an increase of lymphocytes and lymphocytic elements in the blood and enlargement of the lymphoid tissues. It is essentially a disease of middle age, although it may occur at any age. The acute form occurs in young people.

Symptoms.—The symptoms are:

1. Increased weakness and fatigue
2. Pallor
3. Lowered blood pressure
4. Cardiac murmurs
5. Pruritus
6. Enlargement of spleen and liver
7. Enlargement of the lymph nodes throughout the body

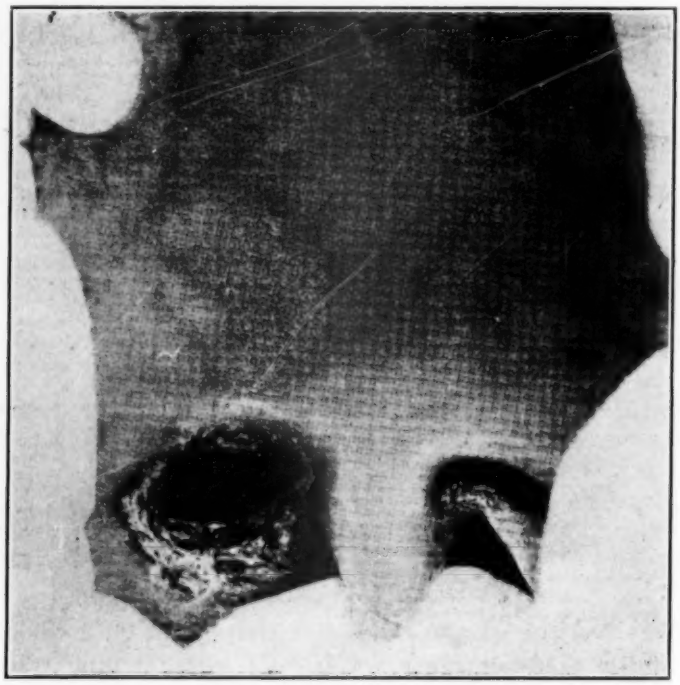

Fig. 8.—Typical necrotic, ulcerated area of Plaut's Vincent's angina.

There is a hyperplasia of the lymphatic structures of the tongue, pharynx, and tonsils. Nodular swellings of the gums appear. The gums clinically show that they are hypertrophied, the surfaces nodular in character, and irregularly raised. The periosteum is not affected, and gums do not bleed easily. The maxilla and mandible are equally affected. As the disease progresses, gangrenous stomatitis and large sloughing areas may be present; a secondary Vincent's sign may manifest itself in this picture.

8. Hemorrhagic phenomena. Petechiae are present; the gums are pale. These manifestations are especially predominant in the acute form.

MYELOGENOUS LEUCEMIA

As far as general symptoms are concerned the myelogenous type practically resembles the lymphatic group. They are:

1. Symptoms of anemia
2. Loss of weight; gradual weakness
3. Loss of appetite
4. Diarrhea
5. Vomiting
6. Itching of the skin
7. Enlargement of spleen and liver
8. Pain over the long bones
9. Hemorrhagic phenomena, petechiae, etc.

Fig. 9.—Pericoronitis. Typical clinical picture of patient with pericoronitis. Notice the inflamed tissue buccally, distally, and lingually to the partially erupted third molar.

There is a tendency toward bleeding gums especially in the acute type and in the acute exacerbations of the chronic form.

Blood Picture.—Let us compare the blood pictures of both types of leucemia. The chronic lymphatic group is characterized by a marked increase in total leucocytic count (100,000). The granular elements are decreased relatively, and at times absolutely. There are practically no eosinophiles, basophiles, and monocytes. The blood platelets are reduced in number. The lymphocytes comprise 90 per cent of the white cells. Other varieties are relatively reduced.

The laboratory findings of the myelogenous group show a hyperleucocytosis. There is an increase in the percentage of granular cells. There is a large number of neutrophiles and immature granular cells (myelocytes and premyelocytes).

In the acute forms frequently aleucemic types are seen, and very immature cells predominate. Generally one cannot differentiate myeloblasts from hypoblasts.

The treatment for these leucemias is x-ray and blood transfusions. Fowler's solution can be used in the myelogenus type. Prognosis is usually unfavorable and ends fatally. Clinically the leucemias must be differentiated from scurvy, hypertrophied tissue, Vincent's angina, purpura, and agranulocytic angina.

Fig. 10.—Leucopenia. This patient had been treated for Hodgkin's disease for seven years. He developed a toothache in the left maxillary premolar region. The tooth was removed. This was followed by nonhealing and ulceration involving the gums, palate, and cheek. The blood count revealed a leucopenia. There were only 600 white cells present. Patient died. (Courtesy of Montefiore Hospital.)

SCURVY

Scurvy is a nutritional disorder resulting from an insufficient intake of vitamin C, characterized by anemia, spongy gums, and hemorrhagic tendencies. The disease is usually due to poor diet, lack of fresh vegetables and citrus juices which contain this vital substance, vitamin C.

Symptoms.—The patient has overworked himself, feels "run down," and has not been eating the proper necessary foods. The skin is yellowish in color,

and hemorrhagic spots appear on the body. Hemorrhages may occur in the deeper tissues causing hard and painful swellings over the legs and abdomen.

In the mouth we have a marked stomatitis. The mucous membrane becomes inflamed. The gums become spongy and swollen and bleed easily on the slightest pressure. There is a marked fetid odor present. The periosteum, as well as the peridental membrane, is involved, and the teeth become loose.

Hemorrhages appear from the mouth, nose, and throat, and blood may even appear in the stools. The patient complains of a disagreeable taste. The tongue is large. In severe cases there are definite bone changes radiographically.

Fig. 11.—Photograph of previous case showing edema present due to ulcerations in the mouth.

Treatment.—Plenty of sunshine, good diet (vegetables and citrus fruits), and cod liver oil are the prescribed treatment for this disease, and cevitamic acid orally, intramuscularly, or intravenously as required.

PURPURA

Purpura is a disease characterized by hemorrhages of the skin and mucous membranes. Several forms are recognized, i.e, thrombocytopenic purpura. When the mucous membrane bleeds freely it is called purpura hemorrhagica. The etiology is unknown. The chronic form is more common than the acute stage. The condition is found more in children, but no age is exempt.

The symptoms of petechiae and hemorrhages are often abrupt. Hemorrhages may occur in the gums, mucous membrane, nose, and even into the urine and bowels. The petechiae vary in size. "Black and blue" spots may appear any place on the body. Slight trauma to the body results in ecchymosis of that particular area.

In the mouth we find these hemorrhagic areas. There is free bleeding from the gums (gingival margins). Extractions or any surgical operation should not be performed in the acute stage. In the chronic stage if extractions are to be performed, one must be careful of a postoperative hemorrhage. The socket must be packed well and a modeling compound block must be used in order to take all precautions to prevent this possible hemorrhage.

Blood Picture.—Laboratory findings show:

1. A marked decrease in the blood platelets
2. A prolongation of the bleeding time
3. A normal coagulation time
4. Signs of anemia

Treatment.—Transfusions, x-ray, splenectomy may be the treatment employed in this disease.

Fig. 12.—Ulcerations from the inner surface of the cheek breaking through, involving the commissure of the lip, and involving outer skin surface.

AGRANULOCYTOSIS

(Synonyms: agranulocytic angina, primary neutropenia, malignant neutropenia, granulocytopenia, idiopathic granulopenia).

Agranulocytosis, the syndrome, first described by Schultz, was characterized by fever, prostration, leucopenia, and gangrenous lesions. The study of this disease has resulted in varied discussions and innumerable dental and medical scientific papers. Appleton suggests that the term be considered as a symptom rather than a clinical entity. Kracke on the other hand considers it a distinct clinical entity. Much more study has to be given to agranulocytic angina.

Many feel that some drug such as amidopyrine or those of the barbital group, allonal, luminal, etc., affect the granulocytic centers in the bone marrow and produce a diminution of the granular white blood cells.

However, it must be borne in mind that approximately eighty million five-grain doses are administered yearly by prescription alone. In contrast with this there are only five hundred deaths per year. Therefore, we must conclude that there must be other factors besides the drug itself involved in causing this disease. Recently the allergic reaction of patients to these drugs has been offered as the probable cause. No definite conclusion has been arrived at yet. Agranulocytosis is still classified as a disease of unknown etiology.

Symptoms.—The general symptoms are:

1. Weakness and fatigue
2. Malaise and fever
3. Sore throat and sore mouth
   The ulcerative patches on the gums and throat are very painful and vascular.
4. Cough
5. Chills
6. Vomiting
7. Rectal distress
8. Dysphagia

In the mouth we have ulcerative and necrotic lesions occurring mainly in the posterior portions. These ulcerations are usually bilateral. There must be a careful differential diagnosis made here between Vincent's angina, pericoronitis, and agranulocytic angina. In pericoronitis we have a unilateral infection usually around the crown of a mandibular third molar. In Vincent's angina we have the necrotic papillae "mouse eaten" border. Vincent's smear will show the fusiform and spirochete B. If in treating a Vincent's angina for several days, there is no appreciable improvement one should suspect agranulocytosis and should have a differential count made immediately.

Extractions and surgery should not be performed in these cases where doubtful necrotic tissues are present.

Blood Picture.—The blood picture is a pathognomonic symptom of agranulocytosis. There is a reduction in white blood count, affecting first the neutrophiles and later all the white blood cells (1300 or less), an absence of polymorphonuclear leucocytes and a relative increase of lymphocytes. Red blood cells and hemoglobin remain practically normal unless a secondary anemia develops.

Surgical procedures are postponed until the patient is no longer considered a surgical risk.

Treatment.—Treatment for agranulocytosis consists of administration of pentanucleotide, liver extract, leucocytic cream, and blood transfusions. All amidopyrine drugs that had been used must be eliminated. Locally, mild alkaline washes are suggested.

THE UTILIZATION OF THE TEMPORAL MUSCLE AND FASCIA IN FACIAL PARALYSIS*

JAMES BARRETT BROWN, M.D., ST. LOUIS, MO.

THE temporal muscle and fascia can be utilized to give anchorage for fascial strips in facial paralysis, and some degree of emotional expression may be developed, if the patient will train the newly substituted fifth nerve muscle and will avoid overactivity of the sound side of the face (Figs. 1, 2 and 3).

Mechanical support, of course, should not be relied upon when nerve anastomosis is possible; but, where the distal branches of the nerve have been torn out—in partial paralysis where it is thought definitely best not to disturb the function already present—and in congenital paralysis, the operation outlined herein is applicable.

Summary of Previous Work.—For direct nerve suture and free nerve transplant, the work of Ballance and Duell has developed much interest in the past few years. Anastomosis with other motor nerves has been effected by many surgeons, and the photographs of patients that showed excellent emotional expression have been recorded.

Eden, in 1911, and Gillies, in 1917, used strips of temporal fascia turned downward over the zygoma to support the face. J. S. Davis, in 1911, and Gallie and Le Mesieur, in 1923, published the results of extensive work on the free transplantation of fascia, and the first report of free fascial strips to support the paralyzed face was made by Blair in 1926. Since this time, descriptions have been made of various methods of fixation of the fascial strips, of use of the opposite frontalis and of flaps of the masseter and temporal muscles from the same side.

Operation for Combining Temporal Muscle and Free Fascia Support.—After consideration and observation of these different methods, a combination plan of operation was developed, in which free fascial strips are put subcutaneously through the face and are anchored directly into the temporal muscle and fascia through an opening in the temporal region (hair-bearing area) (Figs. 1 and 2).

Technic of Obtaining Fascia.—Careful removal of very long strips of fascia lata is accomplished with the Masson or other suitable stripper. An incision is made above the knee about 6 cm. long, and the subcutaneous tissue is carefully separated from the fascia upward, the length of the dissecting scissors; this separation helps in getting the stripper started. At times there are a good many transverse fibers as a separate layer over the longitudinal fibers, and these can be opened through, as they are of no benefit and hinder the action of the stripper. Three or more strips about 1 cm. wide are removed, it being very advantageous to have them long enough for a complete loop through the face

From the Department of Surgery, Washington University School of Medicine, St. Louis, Mo.
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and anchorage in the muscle. Therefore, the removal is started quite low and carried all the way up to the tensor fascia femoris. The 1 cm. width may seem wide, but when it rolls up on manipulation, its bulk does not seem too great.

The leg wound is closed without drainage and a firm bandage put on through the full length of the fascial removal. No objective or subjective trouble has been noted by the author, although others have reported occasional trouble with muscle herniation.

It is possible to use homografts of fascia successfully, and preserved fascia has been employed, but the operation for removal of autografts is simple enough to warrant their use routinely.

Operation on Face.—Diagrammatic course of the fascial strips is shown in Fig. 1, and the scar of operation in Fig. 2 *E*.

A slightly curved incision is made in the hair-bearing temporal region about 6 cm. long, and the temporal fascia is almost completely exposed by retraction.

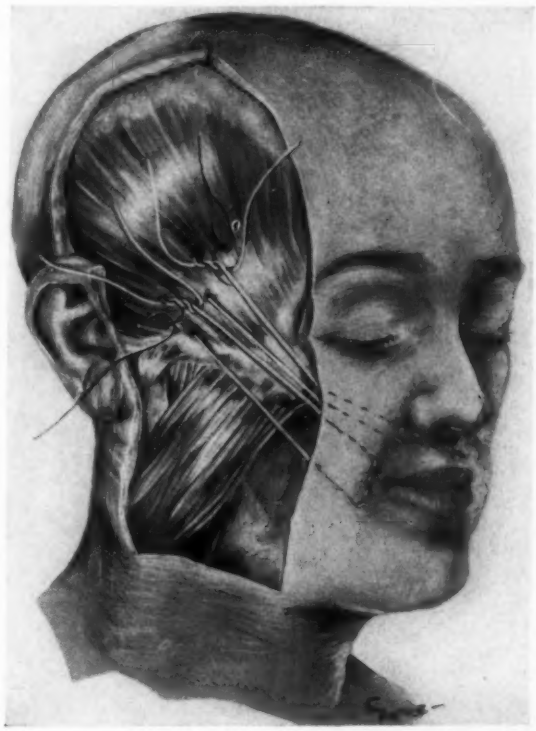


Fig. 1.—Diagram of the free fascial loops' course through the face and fixation in the temporal muscle.

With a long needle, a loop of fascia is threaded from this wound through the subcutaneous tissues of the face and back up through a second different channel into the temporal wound again. To make the loop on the upper lip the needle is brought out through a stab hole in the philtrum or a little to the opposite side. The two courses of the needle through the face are easier if made from above downward. The two ends of the fascia can now be worked back and forth in the temporal wound to establish their firmness and then the lip position can be held straight by the loop. A second loop is now put in as illustrated with an extra curve around the angle of the mouth and, in heavily drooped faces, other loops may be necessary to the ala and farther across under the lower lip.

Anchorage in the Temporal Muscle.—When all loops are in place, one strand of each is carried through the temporal fascia all the way down through the muscle and out again through the fascia 1 to 2 cm. distance. The loops are then pulled tight to overcorrect the face quite noticeably, the first part of a surgeon's knot is put in the loops and they are clamped with two mosquito forceps. Then fixation is firmly effected with three or four No. 000 silk sutures put through the loops and tied around them. An effort should be made to get a secure hold on the muscle in a region where there is the most movement and this is close to the attachment to the coronoid. It might be thought best to completely free the tendon from the coronoid and bring it out for direct attachment to the fascial strips, but this simpler procedure should suffice and the nerve supply is less apt to be sacrificed. (Turning muscle flaps down from the parietal bone seems quite apt to damage the nerve supply—Figs. 1 and 2 *E*.)

The needles used are illustrated in Fig. 4, and it is best to have an eye in the pointed end as there is in the Reverdin needle and in the hollow-tube type used by Blair. If the postmortem type is used, the fascia may have to be attached to it with a long, heavy thread and this needle has to be threaded through, one time, from the lip to the temporal region.

For putting the loops into the muscle a needle of the Reverdin type can be used, or one of the heavy, full-curved fascial type, as illustrated, makes a good curve into the depth of the fossa.

Fascial loops for elevating the lower eyelid are not put deep into the muscle but are fastened into the temporal fascia as the approximation of the lid to the globe should be present at all times and not depend on any conscious muscle activity.

When the fascial loops are all completed, the skin flap is closed, and at this stage if there is much excess skin present, as there is apt to be in long-standing cases, it may be excised along the margin after pulling the anterior flap up tightly and determining the amount of excess. This will necessitate extending the incision down over the crus of the helix and tragus and undermining the skin quite far out on the cheek. When this is all accomplished, the result is that the deep tissues are elevated and attached to the temporal muscle; the excess facial skin has been excised and the skin reattached to the scalp for fixation. There is almost always better approximation of the lower lid to the globe because of the elevated face, even if there has been no tendon loop put in the lower lid (Figs. 2 and 3).

Badly drooped cheeks in patients with thick skin and subcutaneous tissue may need to have the excess skin removed at a second operation because it sometimes has to be elevated so far and the wound edges held so tight that healing is delayed; and that is, of course, not desirable over the freshly transplanted tendons. For this reason, if possible, the operation for support of the face should be performed before marked sagging has taken place.

Tendon transplants do not stand infection well and every effort should be made for a clean operation even though it is carried out right at the mouth opening. Intratracheal anesthesia with the tube coming out the opposite angle of the mouth is probably the best.

Fig. 2.—*A* and *B*, Traumatic facial paralysis in which nerve repair was impossible.

C and *D*, Result of one stage operation as described here, with good facial level and some emotional expression. Patient stated that he attended college with very few persons knowing his face was paralyzed.

E, Operation scar and course of tendons through face.

F, Good closure of eye, obtained by elevating face without putting separate fascial loop through lid. This is also helped by performing the operation before excessive sagging has taken place. (The flap on the neck is for reconstruction of the ear.)

Postoperative Course.—A large pressure dressing, using either marine sponges or fluffed mechanic's waste, is put over the entire side of the face including the eye, after strapping it shut with adhesive. Chewing is prohibited. After several days the face can be held supported with collodion and fine mesh gauze which is fastened along the lips and cheeks and then in the temporal region above the incision. This can be kept on two to three weeks and then activity allowed. There may be a long period of swelling and the overcorrection may seem annoying, but secondary adjustments are usually for tightening rather than loosening the tendons.

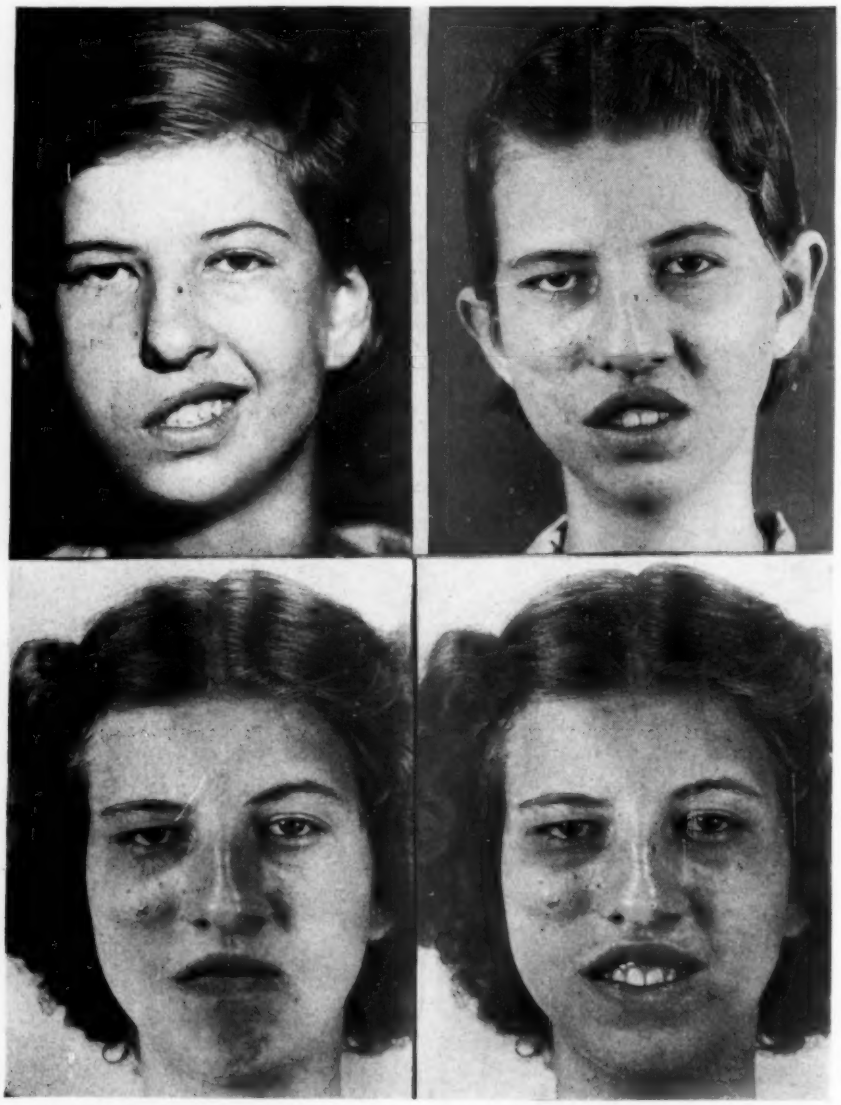


Fig. 3.—*A*, Complete facial paralysis—congenital.
B, Result of the described operation showing motor power of the (fifth nerve) temporal muscle elevating the lip in a slight smile to give some degree of emotional expression.
C and *D*, Later photographs to show persistence of result and also improvement in control of the face and in emotional expression.

Results of Surgical Treatment.—With subsidence of the swelling, the face usually smooths out and the tendons can be felt in the cheek. Electrical stimu-

lation of the facial muscles can be maintained if desired, but, if the tendons work well, the tone of the face seems to be satisfactory. After some weeks, the conscious muscle activity of setting the closing muscles of the jaw should come into play and give some degree of emotional expression (Figs. 2 and 3).

Facial Muscle and Speech Training.—One of the most important points, for a successful outcome, is that the patient should train his facial movements. This includes the use of the newly attached fifth nerve muscle which will produce a slight smile and a nasolabial fold on a slight setting action of this closing muscle; and, of equal importance, is learning not to overact on the sound side. It seems that many people with facial paralysis, in speech and laughter, throw about twice as much movement into the sound side of the face as they probably would if both sides were working. Therefore, a fundamental of the training might be for these patients to try to become rather "glum" and work from this point towards a limited movement on the sound side and an involuntary or subconscious setting of the fifth nerve muscles on the repaired side, in smiling. Of course, sudden emotions will always register mainly on the sound side; there is probably no way of controlling this, and it would be the same even with a successful nerve anastomosis.

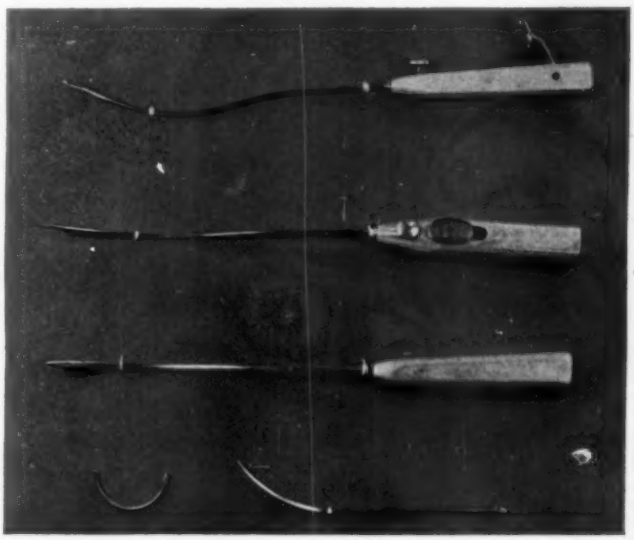


Fig. 4.—Various needles for threading fascia through face. First and third: Type of needles used by Blair. Second: A modification of the first needle by Smith. Below: A long postmortem type of needle for going through face and a full curved fascial suture needle for anchorage in the temporal muscle.

If there are other speech defects, such as lisping, training by a professional should be of great value, because everything that will help to prevent other persons noticing the face of one of these patients is desirable.

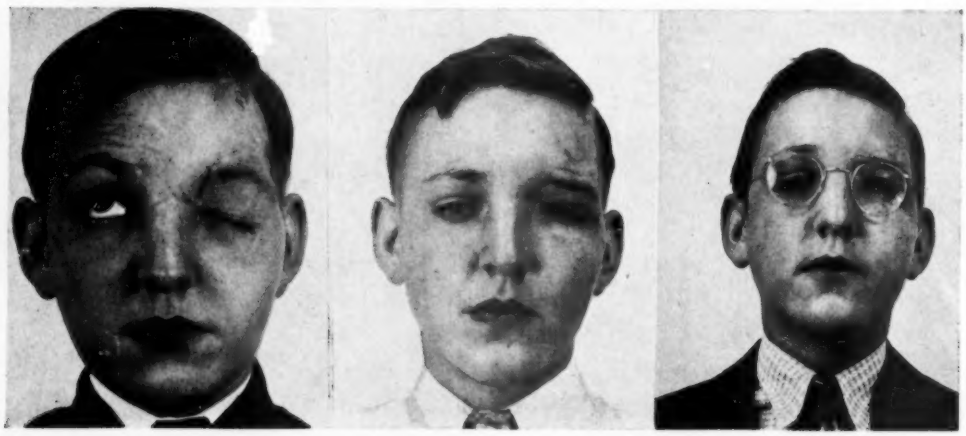
Eye Involvements.—As has been mentioned before, some elevation of sagged lower lid is obtained by the operation on the face (Fig. 2 *F*). If it needs further support, a single fascial loop can be put through the lid and held on each end, above in the opposite frontalis—which may give some slight emotional expression—and on the outside in the temporal fascia.

Heavy drooping brows may be raised by extending the skin incision over the forehead, undermining down to the brow, elevating and excising the excess skin, and reattaching it to the scalp.

For the apparent exophthalmos a small external canthoplasty can be performed to narrow the opening. Cervical sympathectomy has been recommended to produce the enophthalmos of a Horner's syndrome, but this procedure would be contraindicated if there were already a heavy overcast eyebrow.

When ptosis of the upper lid exists with seventh nerve paralysis, the problem of getting the lid elevated becomes very acute. If an extraocular muscle operation will not suffice, the lid can be elevated with a single loop of fascia from the temporal fascia, through the tarsal border of the lid, across to the opposite frontalis. An extra loop may be necessary to help in the elevation and may be attached above to the inert tissue in the forehead. This implies that the lid will be held open all the time, and trouble with the cornea will result if it is not kept protected carefully (Fig. 5).

The use of fifth nerve muscles is not recommended in trying to get elevation of the upper lid because of giving movements that would appear too gross and too conscious.



A. *B.* *C.*

Fig. 5.—*A*, Complete ptosis of the upper lid, from a third nerve lesion and paralysis of the frontalis (seventh nerve) muscle from the local scar.

B and *C*, Elevation and some degree of emotional expression in the lid by attachment of lid to the forehead with fascia and by a second loop of fascia from the temporal fascia through the tarsus to the opposite functioning frontalis.

DISCUSSION

Dr. Walter E. Dandy (Baltimore, Md.).—I have been very much impressed with the brilliant results of Doctor Brown in this field. His contribution is, I think, the insertion of the fascia into the temporal muscle. I have often wondered whether this might not be a better treatment of those cases of facial paralysis where a nerve transplant is the usual procedure. I wonder if these results may not actually be superior to an anastomosis of the spinal accessory or hypoglossal nerves which would then not be sacrificed. Certainly the results are very good. I have performed a few of them and have been much impressed with the muscular control which one can get through the use of the temporal muscle.

Dr. James Barrett Brown (St. Louis, Mo., in closing).—I am not qualified to evaluate the end results of nerve anastomosis, but many very worth-while results have been published. In those patients not suitable for nerve anastomosis, the operation described here may give the most satisfactory result.

There have been descriptions of fifth nerve muscle flaps from the temporal and masseter to the eyelids, but when approximation of the lid to the globe is such a constant necessity, it seems improbable that fifth nerve muscles would afford much comfort. It is probably best to fasten support in the temporal fascia, carry it through the lid and anchor it near midline or even up in the opposite frontalis.

THE DEVELOPMENT OF CARIES IN THE TEETH OF ALBINO RATS FOLLOWING EXTIRPATION OF THE SALIVARY GLANDS

DAVID WEISBERGER, D.M.D., M.D., C. TRUMAN NELSON, D.M.D., AND PAUL E. BOYLE, D.M.D., BOSTON, MASS.

RECENTLY Cheyne[1] has described a technique for the removal of salivary glands from rats. Since experiments involving extirpation of salivary glands by a different technique have been in progress in our laboratories for more than a year, it seems desirable that a brief account of our findings should be made at this time.

Following total extirpation of the major salivary glands the rats quickly developed a pronounced xerostomia, and within fourteen to eighteen days a severe hypertrophic gingivitis with recession of the gingival tissue about the anterior teeth was evident. This change appeared to be the result of impaction of food and accumulation of debris about the gingival attachment of the teeth. Post-mortem examination revealed similar but less severe changes in the tissue about the molar teeth. The accumulation of debris about the gingival attachment was found on microscopic examination to be associated with ulceration of the soft tissues and marked resorption of the alveolar bone. Caries developed on the exposed surfaces of the molar teeth. The carious process, which was possibly primary in the cementum, also involved the enamel and dentine. Secondary dentine was present as a result of the carious process. The earliest observation of the caries was twenty-two weeks after operation. Thus far, fissure caries has not been observed.

Comparison of the oral flora in operated and normal rats has shown that the development of even the earliest pathologic processes described above was associated with a marked increase in the total concentration of microorganisms. No significant changes in the variety of microorganisms were demonstrable. However, when hormone agar at pH 5.0 was used, a distinct increase in the quantity of *B. acidophilus* and certain types of staphylococci was demonstrated. This change became more marked as the survival time after operation was prolonged.

Following recovery from operation, there were no apparent ill effects on the subsequent growth and development of the rats. Operated and control rats were maintained on a diet of Ralston Purina Dog Chow.

This experimental procedure affords a method of initiating dental caries in a laboratory animal. The results so far tend to confirm clinical observations reported by Trimble, Etherington, and Losch,[2] who found a positive correlation between low salivary volumes and a high incidence of caries in human patients.

Histologic, bacteriologic, and chemical studies are being continued.

REFERENCES

1. Cheyne, V. B.: J. Dent. Res. 18: 457, 1939.
2. Trimble, H. C., Etherington, J., and Losch, P. K.: J. Dent. Res. 17: 299, 1938.

From the Harvard Dental School.

Case Reports

Dr. Henry Goldman submitted a report which illustrates the effect of systemic disease on the oral tissues.

Case reports for this department should be sent to Dr. Kurt H. Thoma, 53 Bay State Road, Boston, Mass.

CASE REPORT NO. 34

ACUTE ALEUCEMIC LEUCEMIA

HENRY M. GOLDMAN, D.M.D., BOSTON, MASS.

THE essential feature of leucemia is a neoplastic proliferation of the leucoblastic tissues, as a result of which there is a great increase in the white cells of the blood. The increase may affect the myeloid cells (myelogenous leucemia), the lymphoid cells (lymphoid leucemia), or the monocytes (monocytic leucemia). Occasionally there is a proliferation of white cells in the tissues, though they fail to appear in the blood stream. Such a condition is called *aleucemic leucemia.* It is not a separate disease entity, but merely a phase of the leucemic state, for sooner or later the blood becomes flooded with white cells. Even before this happens abnormal types of leucocytes may be found in the blood, although the total count is not raised.

The leucemias fall into three main groups: myelogenous, lymphatic, and monocytic. To these may be added a fourth: *acute leucemia.* The distinction between the fully developed and classical types is very easy. The more acute the disease, however, the more difficult it is to be certain of the nature of the abnormal white cells, for it is the primitive blood cells which appear in the acute cases, and these lack distinguishing characteristics.

Fig. 1.—Aleucemic leucemia.

Symptoms.—The clinical manifestations of the three main forms of leucemia differ considerably. The age incidence of acute leucemia is in early life for it is most common in the first five years. Myelogenous leucemia occurs between the ages of 25 and 45 years, and lymphatic leucemia between the ages of 45 and 60. The patient suffers from the usual weakness, dyspnea and palpitation of severe anemia, due to the replacement of the erythroblastic tissue

in the bone marrow. Hemorrhages are common in all varieties, particularly in the acute form, so that leucemia is classed as one of the "bleeding diseases." There may be hemorrhage from the nose, mouth, or bowel, or into the brain or retina. Bleeding gums and necrotic processes in the mouth associated with fever and severe and progressive anemia are characteristic features of acute leucemia.

CASE HISTORY

Early Development.—The patient, a male, was born on March 19, 1900. At the age of 3½ years he was operated on for hernia. Other than this he had never been sick. At the age of 14 years he could lift 100 pounds with ease.

Past History.—A physical examination in 1923 showed the patient to be an obese, well-developed man. Aside from questionable teeth and ankle clonus the examination was essentially negative. The Wassermann was negative. The blood hemoglobin was 85 per cent; polymorphonuclear leucocytes 69 per cent, lymphocytes 25 per cent, large mononuclears 6 per cent, and erythrocytes normal.

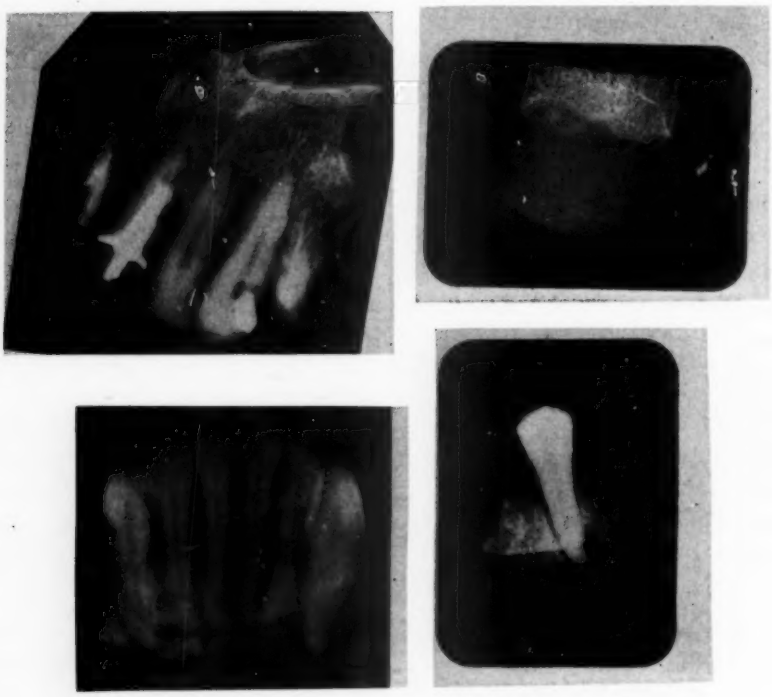


Fig. 2.—X-rays of sections removed at autopsy.

In 1925 another examination showed some oral sepsis with the left tonsil hypertrophied. The deep reflexes were hyperactive. Blood hemoglobin was 90 per cent; white blood count 12,800, Wassermann negative.

The physical examination in 1927 at the age of 27 years showed a well-nourished, obese man. The pupils were equal and reacted to light and accommodation. The patellar reflexes were hyperactive. There was no Romberg, Babinski, or clonus. There was no evidence of gout, rheumatism, or syphilis, and the lungs and heart were negative.

A physical examination was made in 1929 and 1935, and the patient was in good health.

The patient's teeth were examined in 1923, and he had many crowns and teeth that needed care. In 1925 extensive bridges were present. X-ray examination revealed small areas at the apical and periapical regions of the maxillary right first and second molars and mandibular right first molar. These teeth were extracted.

The patient had regular care up to September, 1936, when he complained of severe mouth symptoms. This was diagnosed as Vincent's. However, the mouth condition did not improve on treatment with salvarsan.

Present Illness.—In September, 1936, the patient complained of mouth symptoms and on one of his visits to the dentist collapsed. Examination at the time showed a well-developed male, whose pulse was very fast (about 120). Heart sounds were rapid and somewhat distant; they were regular however. Temperature was normal, and no pathology in the chest was noted.

Fig. 3.—Microscopic section of parodontal structures between the second mandibular incisors, showing necrosis of the gingival corium. The bone marrow is fibrosed.

The patient became progressively worse. Two days later his temperature was 105° F., pulse 120, respiration 36.

The oral cavity presented a striking picture. The mucous membranes were injected and slightly swollen. Minute petechial hemorrhages were scattered

throughout the mouth and were most numerous around the incisor teeth of the maxilla. The gingivae were necrotic and hyperemic; they were of dark blue color. The tongue was slightly swollen and heavily coated with a grayish-white material. A foul penetrating odor emanated from the mouth. The teeth were very loose.

Blood examination revealed the following: hemoglobin 32 Talquist, 20 Sahli, red blood cells 850,000, white blood cells 1,390, polymorphonuclear leucocytes 5 per cent, large and small lymphocytes 48 per cent, monocytes 30 per cent, basophiles 0, abnormal: myeloblasts 2 per cent, myelocytes 10 per cent, lymphoblasts 5 per cent, reticulocytes 75 per thousand. Polymorphonuclear leucocytes were disappearing; myelocytes, myeloblasts, and especially lymphoblasts were increasing. Platelets were absent. Hydase test was positive.

The patient died two days later.

Histopathology.—The teeth obtained at autopsy were the maxillary left central incisor, the maxillary right central and lateral incisors, canine, and first premolar. The six mandibular anterior teeth (canine to canine) were also obtained. A section of the rib was removed. All these were radiographed and clinically studied.

Microscopic examination of these sections revealed many interesting facts. How much may be attributed to the aleucemic leucemia is questionable. There are, however, many pathologic conditions which were due to this blood dyscrasia, and it is these that I shall describe.

The gingivae were markedly affected. No epithelium was present and the gingivae appeared necrotic, as seen in a case of Vincent's. This may be due to treatment with salvarsan applied two days before death. Cellular debris covered the entire gingivae, which represented the necrotic tissue seen clinically. The dense connective tissue of the gingival corium was replaced with loose strands with numerous blood vessels. The entire structure was studded with myocytes. The transeptal fibers had almost entirely disappeared. Here and there remnants of this structure could be seen.

The bone marrow was greatly changed. Fibrous marrow now replaced the fatty marrow usually seen. Premature blood cells were scarce and not seen in abundance as in the case of the gingivae. One unusual fact was that red blood cells could be seen in the connective tissue of the marrow (diapedesis).

Department of Orthodontic Abstracts and Reviews

Edited by

DR. J. A. SALZMANN, NEW YORK CITY

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City.

Orthodontic Aid in Periodontia and Prosthesis: By R. Fraenkel, *Rev. de Stomatologie* **30**: 614-616, 1939.

A patient 42 years of age had been suffering from a paradontosis for a number of years. The resorption of the alveolar process had produced mobility and displacement of the teeth, especially the maxillary incisors. As a result, the patient was conscious of his disfigurement caused by the protruding incisors. From the standpoint of function, the patient was unable to use his teeth and his speech was also affected. The age of the patient was one hardly considered favorable for orthodontic treatment.

With the consent of the patient, the author undertook to retract the teeth by orthodontic means and to stabilize them with the aid of a fixed prosthetic appliance. Since the patient objected to a labial appliance a lingual appliance was used, fitted to first molar bands.

The retractive movement of the incisor teeth was accomplished in about six weeks. At the end of this period a bridge was placed in position.

Figs. 1 and 2.

Because of the extreme mobility of the teeth, it is usually necessary to hold each tooth between the fingers while the preparation is being made. Moreover, the mobility of the teeth made it difficult to stabilize the various members in order to take an impression. In order to overcome this inconvenience a harness was constructed of a rigid but thin metal 2 to 3 millimeters in width. One piece of the metal fitted labially and the other lingually near the gingiva. The two bars fitted about the teeth and were held together by screws and nuts which passed interdentally. Thus the teeth were stabilized and the work of constructing the bridge was undertaken. When the prosthetic appliance was placed in position, the double harness used to stabilize the teeth was easily

removed. The harness must include as many teeth as possible in order to obtain stabilization, it should preferably run across the median line.

In making this particular appliance, the author constructed four carmichael crowns on the incisors and pin inlays on each of the canines. As a result of this treatment the patient was helped from the point of view of function, esthetics, and phonetics.

A Case Treated by the Skull and Chin-Cap Method: By S. A. Riddett, L. D. S., *Dent. Record.* **59**: 471-476, 1939.

A case is reported of a child 3 years and 3 months of age who was treated by means of an aluminum chin cap and a cloth headcap attached to each other by means of elastics. The child wore the appliance day and night for a period of five months, at the end of which time the maxillary central incisors occluded labially to the mandibular teeth. Since the child refused to wear the appliance any longer, it was discarded. At age 11 the occlusion was still normal although the mandible showed somewhat more than normal developmental growth.

Revision of Dental Symbols: By Bruno Oetteking, Museum of The American Indian, *Science* **90**: 464-465, 1939.

Oetteking makes reference to an article by E. S. Riggs in which the latter suggested simplifying the typographical complexity of dental formulae as they are employed in anthropologic and paleontologic literature. Riggs' suggestions were for the purpose of making it easier for the typesetter. Oetteking has developed a system over a period of years which can be easily followed by dentists and orthodontists as well as by anthropologists and others.

In this system, teeth are recorded with regard to their denomination and state of preservation as well as to their presence or absence in the dentures of the maxilla and mandible. For the former he uses the Arabic, for the latter he uses the Roman characters. The method which follows holds for both permanent and deciduous teeth:

Adult (permanent) dentition:

8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1	1	2	3	4	5	6	7	8

Infantile (deciduous) dentition:

V	IV	III	II	I	I	II	III	IV	V
V	IV	III	II	I	I	II	III	IV	V

The figures in these schemes account for the number and denomination of teeth in each jaw quadrant, namely, eight (8) in the permanent and five (V) in the deciduous. In cases of gradual replacement of the deciduous by the permanent teeth or by the addition of the gradually erupting molars, the deciduous scheme is to be varied by the substitution or addition of Arabic numbers according to the individual status of the developing dentures.

The individual teeth in each jaw quadrant are symbolized by initial letters, capitalized for the permanent teeth and indicated by small letters for the deciduous teeth, and in addition to their serial numbers either above or below

the line indicative of their positions in the upper and lower jaws. Thus, I^1 signifies a maxillary permanent first incisor tooth; Pm_2 *a* mandibular permanent second premolar; m^2 a maxillary second deciduous molar (to be replaced by Pm^2) and so forth. Right and left furthermore may be signified either by an additional *r* or *l*, so that M_{1r} stands for a mandibular right first molar, i^{21} for a deciduous maxillary left second incisor.

As regards their state of preservation, individual teeth may either be nonerupted, lost, pathologic, or in process of eruption. The following list in a summarized form accounts for these features, as also for those described above:

1 – 8, indicating the permanent teeth of an adult jaw-half in mesiodistal orientation;

I – V, indicating the deciduous teeth of an infantile jaw-half in mesiodistal orientation;

I = incisor
C = canine
Pm = premolar
M = molar
} Symbols (capitalized initials) of permanent teeth

i = incisor
c = canine
m = molar
} Symbols (small initials) of deciduous teeth

State of preservation of teeth in the dental schemes:

–, indicating non-eruption;

x, indicating post-mortem loss of tooth as shown by an empty alveolus, or a possible intra-vitam loss with a more or less obliterated alveolus or a more or less distinct gap remaining;

( ), indicating a pathologic tooth, *e.g.*, (3);

○, a tooth in eruption.

Tentatively applying the last four symbols to the adult dental formula, the latter may individually occur as follows:

x x x x 4 3 (2) 1	1 2 3 (4) x 6 x 8
○ 7 6 x 4 3 2 1	1 – 3 4 5 6 7 ○

According to this formula and also using some of the other symbols, the state of dental preservation accounts in the right half of the upper jaw for a pathologic I^{2r} and a missing Pm^{2r} and missing M^{1-3r}, in the left for a pathologic Pm^{11} and a missing Pm^{21} and M^{21}, while in the right half of the lower jaw Pm_{2r} is missing and M_{3r} in eruption, the left half accounting for a nonerupted I_{21} and M_{3l} in eruption.

Tumors of the Salivary Glands: By Joseph W. Houck, *Surgery* **6**: 550-584, 1939.

Since the evaluation of prognostic data is impeded by the lack of uniformity in pathologic nomenclature and classification, the author feels justified in presenting a brief summary of pathology and treatment.

The most frequently encountered of all salivary tumors, by far, belong in the so-called mixed tumor group. These may show either benign or malignant characteristics and consist of both epithelial and connective tissue elements. Most salivary tumors of clear-cut malignancy are considered to be adenocarcinomas, although the distinction between these and malignant mixed tumors is not well defined. Sarcoma is rare. The prevailing theories of histogenesis are summarized by the author.

Efforts at classification have been only partially successful because microscopic differentiation of the benign from the malignant is frequently impossible. The clinical behavior of individual tumors is quite variable, and often does not conform to the microscopic picture. Ahlbom prefers the term mucous and salivary gland tumors to include all tumors of the salivary glands as well as similar tumors occurring about the head and neck. The classification developed by Renterwald of Stockholm is given in detail.

The author presents the histologic criteria of malignancy of salivary gland tumors. The average age incidence is 37 years, the youngest patient was 2 years and the oldest 84. The typical mixed tumor of the parotid region is considered as the prototype for salivary tumors, both in histologic structure and clinical course. About 20 per cent of malignant tumors of the large salivary glands present lymph node metastasis in the neck, but distant metastases are almost never demonstrable in the stage in which a patient comes for treatment.

The traditional treatment has been surgical, but radical surgery is dangerous, and is not infrequently followed by recurrence. Preliminary biopsy is seldom justified, a clinical preoperative diagnosis is preferable, particularly since pathologic classifications have proved unsatisfactory as a guide for therapy. A therapeutic trial with irradiation appears to be a valuable guide in diagnosis and treatment. The radio-sensitivity of malignant salivary tumors is comparable to carcinomas of the breast and squamous cell cancer of the mouth which are among the more radioresistant squamous cell cancers. Benign tumors are essentially ray resistant.

Facial nerve paralysis is a frequent injury, but is more common after removal of malignant tumors when the nerve is deliberately sacrificed. Other postoperative complications, such as salivary fistula and ankylosis of the jaw, are unusual.

A new classification is offered based entirely on clinical findings, as a basis for treatment and prognosis. Pathologic and clinical data as well as histologic and clinical criteria for determination of malignancy are presented in detailed tabular form. The author bases his views on his own experiences and on reports in the literature and presents the following general outline of treatment:

Group I. (small and freely movable).— Treated by surgical excision, unless the patient is aged and debilitated and the tumor is of long duration and slow growing. A preoperative therapeutic test of high voltage x-ray therapy is optional. If section of operative specimen indicates possible malignancy, irradiation either by radium element in the wound or by deep x-ray therapy is indicated.

Group II. (*Large and Freely Movable*).—Fractional x-ray therapy preliminary to operation (Ahlbom), depending upon response to irradiation, operative excision should be performed in most instances. The cosmetic deformity of the tumor should be compared with the chance of facial nerve paralysis.

Group III. (Large and Fixed).—External irradiation in a course of fractional doses is the only logical treatment. Implants of emanation should be avoided. Surgery is usually contraindicated (facial nerve injury, 33 per cent; recurrence 60 per cent).

Tumors which were inoperable by ordinary methods, Hybbinette removed successfully by intracapsular curettage followed by blunt dissection removal of the capsule. Recurrence rate was 4 per cent, and no facial nerve injuries followed.

H. A. Salzmann, M.D.

Book Reviews

The Endocrine Glands: By Max H. Goldzieher, M.D. Endocrinologist, Gouverneur Hospital and Brooklyn Women's Hospital, New York; former Professor of Pathology, Royal Hungarian University, Budapest, Illustrated, pp. 916, New York, 1939, D. Appleton-Century Co.

Goldzieher started his investigations of the endocrines over thirty years ago. In the present volume, he attempts to correlate the accumulated knowledge on endocrinology along practical lines and to provide a work of reference.

The chapters on disturbances of growth will be found especially interesting to orthodontists as will every phase of endocrinopathy. Our present state of knowledge of dental conditions in relation to the endocrines is still in an unsettled state. Orthodontists are torn between the conservatism of laboratory workers such as Schour who warns them against the acceptance of categoric statements concerning endocrinologic correlations in malocclusion and such clinical endocrinologists as Engelbach, Wolfe, and Goldzieher. The present author is careful to include all dental symptoms in the various diseases. The book has an excellent bibliography, is well illustrated, and has a good index.

Pediatric Surgery: By Edward C. Brenner, A.B., M.D., F.A.C.S., Associate Professor of Clinical Surgery, New York Post-Graduate Hospital; Director of Surgery, Riker's Island Hospital; Director of Surgery, Detention Hospital; Attending Surgeon, Midtown Hospital; Consulting Surgeon, Hunt's Point Hospital; Octavo, 843 pages, illustrated with 293 engravings, Cloth, $10.00 net, Philadelphia, 1938, Lea and Febiger.

This volume is largely based on the author's lectures at the New York Post-Graduate Medical School of Columbia University. The author has restricted himself to material of practical value, discussing the important common pathologies but omitting orthopedic conditions.

Harold S. Vaughan has contributed a chapter, *Congenital Cleft Lip and Palate.* This reviewer has never before seen this subject discussed in as master-

ful a fashion as it is done here. Vaughan presents striking photographs of operated cases and explains his technique in detail.

Regarding the cooperation of the orthodontist, Vaughan points out that, "the assistance of the orthodontist is essential in many cases after the surgery has been completed. Even when the alveolar border is well adjusted in unilateral complete cleft lip, the later development may not be sufficient to produce proper occlusion with the lower teeth." The book is of great value to those interested in surgery as it applies to children.

Practical Child Psychotherapy: By Curt Boenheim, Sometime Director of the Clinic for Nervous and Difficult Children at the Kaiser and Kaiserin Friedrich Kinderkrankenhaus, Berlin, Now in Association with the Tovestock Clinic, London; Pp. 177, Price 10 shillings 6 pence, 1938, Published by John Bale Medical Publications, Ltd., 85 Great Titchfield St. W. 1., London, England.

This book is based on experience the author gained when practicing in Berlin over a period of ten years as a child psychotherapist. Orthodontists who are anxious to know as much as possible about the psychic background of their patients will naturally be interested in this volume. Control of habits has long been recognized as an important therapeutic factor in the elimination of dentofacial disturbances, although the extent of their etiologic responsibility is as yet far from certain.

Regarding thumb-sucking in infants, Boenheim says the following: ". . . thumb-sucking is so widespread that one can hardly speak of it as pathologic without considering its intensity and the age of the child." This little volume will give the orthodontist a keener insight into the personality of his child patients.

Editorials

Oscar Busby

THERE are but few who are able to enjoy more personal popularity among their confreres throughout a lifetime of practice than did Busby, of Texas. His genial smile, and ever-ready wit, a sense of humor without a peer, made of him somewhat of a colorful character, a kind of a Will Rogers, as it were, among his orthodontic confreres, not only in America, but in Europe as well. In his younger days no orthodontic get-together or banquet, no matter where held, was thought to be complete without the Busby touch, not only because of its value as a humor asset, but because men could not possibly take themselves too seriously as individuals in the presence of this radiant personality.

He had a way, it is said, all of his own, and a philosophy of life, together with its expression, that was devastating to any form of intolerance in either the great or the near great. It was often said of him that he was the only man in his profession who could make the sphinx laugh, and in addition to this, he was one of the few who could completely and helplessly disarm the late formidable Martin Dewey in forensic repartee by using his characteristic role of "only a country boy who has studied a smattering of Latin."

He was known as Oscar throughout the land, rarely as Doctor Busby. There is an important place in professional life for men of his type and character, for men who have that rare accomplishment of being able to radiate happiness and cheerfulness into the somber lives of others not so fortunately endowed with the spirit of optimism during life's journey. He was wholesome and he enjoyed the confidence of people; an honest fellow with a modesty pertaining to his own personal talents and interests that was always concealed behind a jest.

Let us hope the world is able to produce more of this type in professional life. If there were more of this personality there would be more happiness, tolerance, and good will toward men. His memory will live as a man who contributed much to his profession by making the path of his confreres bright and cheerful. In retrospect he will, no doubt, live in its heart, reflecting some of the bright days in orthodontic progress as a new specialty.

Oscar left his own imprint on the early history of the specialty, highly individualistic, but none the less important, and it is easy to imagine him genially waving his hand in departure from life in the same happy spirit that he lived. Another orthodontic pioneer has gone to his reward, and the world was made happier by his living.

H. C. P.

Our Twenty-Fifth Birthday

THIS issue of the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY marks the beginning of our twenty-sixth year. A quarter of a century of service to the specialty of orthodontics is behind us. The type of service rendered can be visualized by the 25 bound volumes of the JOURNAL that are scattered

along its trail. It is said that to reminisce is to acknowledge that one is growing old, but age is nothing of which to be ashamed unless there has been a riotous waste of one's existence. It is a pleasure to me to call up in imagination the early years of this JOURNAL'S life. Looking back I visualize its struggles—the days when there were scanty supplies of material to be published; when sharp shooters were stationed behind every rock and bush sniping at us; when specialism in the dental journal field was new; when the orthodontic specialty itself was torn asunder by strifes within its ranks; when it could muster only a handful of workers; when only one in every ten dentists knew the real definition of the word orthodontics; when very few dental schools gave other than a gesture course on the subject in their curriculum; when the editor, Martin Dewey—always the stormy petrel of dentistry—needed only to swing his warclub in a dental meeting to bring on a riot.

Much water has gone over the dam since number one, volume one was released on a dull gray morning in January, 1915. Looking back now upon those early days, I realize the truth of the old maxim that "Fools rush in where angels fear to tread." I cannot help but feel now that Dewey and I were the embodiment of all this adage means. Now that the first quarter of a century in this JOURNAL'S life is over, I cannot help but get a glow of satisfaction out of what it has helped to accomplish for orthodontics, when I see the American Association of Orthodontists well on its way to 1000 members, note the feeling of good fellowship in evidence everywhere within its ranks, and take cognizance of the strides it has made. I am glad that Dewey and I "rushed in where angels feared to tread." My vision is clouded a bit by the mists that hang low on the eyelids as I remember the valiant fighter from the Kansas plains who dared to take the editorship. He sleeps under Kansas skies, but the seed he planted and watered with the sweat of honest efforts has yielded an abundant harvest, in the form of one of the richest volumes of written history ever assembled for any department of either medicine or dentistry.

C. V. M.

Raise in Subscription Rates

Dire necessity has made a raise in subscription price to the AMERICAN JOURNAL OF ORTHODONTICS AND ORAL SURGERY imperative. Increased production costs of all descriptions that go to make up a journal have brought this about. The price for this JOURNAL for new subscriptions and renewals will be $8.50—an increase of 12½c a month through the year. The new price will be in keeping with that charged by other special journals in the medical field. Every effort will be made to improve the service rendered. Illustrations have always been a special feature of this JOURNAL. This feature will be maintained and whenever possible improved upon. Nothing but high-class advertising will be accepted. The best class of workmanship will be carried out in the JOURNAL'S make-up.

THE PUBLISHERS.

In Memoriam

Oscar E. Busby

"The moving finger writes, and having writ moves on."

—Rubáiyát of Omar Khayyám.

ONE of the first two orthodontists to locate for the practice of orthodontics exclusively in the Southwestern part of the United States was Oscar E. Busby of Dallas, Texas. Dr. Busby was one of two who pioneered the subject in that State. He passed on at the age of 62 years, December 22, 1939, after a long illness.

He was born in Woodville, Texas, and was graduated from Baylor University, Waco, Texas, in 1894. He then attended Tulane University Dental School, also Atlanta Dental School, graduating there in 1897. He was a past-president of the Dallas County Dental Society, of the Southwestern Society of Orthodontists; vice-president of the American Association of Orthodontists; and a vice-president of the First International Orthodontic Congress.

OSCAR E. BUSBY

He was a member of the American Association of Orthodontists; certified by the American Board of Orthodontics; Southwestern Society of Orthodontists; Texas Society of Orthodontists; American Dental Association; Texas State Dental Society; Dallas County Dental Society, and the European Orthodontological Society and for many years held the chair of Professor of Orthodontics at Baylor University Dental College, Dallas, Texas. Twice he was president and leader of the Alumni Society of the Dewey School of Orthodontics.

Dr. Busby was a 32 degree Mason and a member of Hella Temple, and the Christ Episcopal Church of Dallas.

Certain requirements are vitally necessary as a foundation to one who would emulate the life of the late Oscar E. Busby. Of first importance one must have a never-ending love of mankind. He sought to know and was a scholar; he was tolerant and humble, therefore a gentleman born; his was a philosophy of life which gave freely, thus reaping a reward of endearing friendships and the joy of living. All of this was evidenced by the ready smile, gay homely wit, and constructive study and thought which promoted progress of his profession.

However, we need not eulogize one who needs no eulogy. To know him was to love him. To be his friend was an honor and a privilege. As was his just due he had received, unsolicited, all the honors his profession could bestow upon him.

A loving husband, he leaves a companionship of thirty-seven years which to intimates was known as Maude and Oscar. It is comforting to the family and friends to know that he was laid to rest with tender hands, endearing thoughts, and blankets of beautiful flowers. One has the sincere belief that even though the ears could not hear, he knew how he was held in our hearts; that even though the eyes could not see, he visualized the token of our devoted farewell; that if the tongue might speak he would admonish us not to grieve for him but to protect, in his absence, his loved ones. Oscar had lived life to the full and his unnumbered friends, sorrowed with his passing, wish him "Rest in Peace" everlasting.

P. G. S.

Ransford B. Van Gieson

The friends and confreres of Dr. Ransford B. Van Gieson, orthodontist of Montclair, N. J., were shocked to learn of his death, Dec. 8, 1939.

He was a graduate of New York College of Dentistry in 1900, and practiced general dentistry in Montclair until 1921 when he opened an office in the Medical Arts Building, Newark, and specialized in orthodontics. Later he maintained offices in Medical Tower, Newark.

He was a member of the Essex County Dental Society, New Jersey State Dental Society, American Dental Association, American Association of Orthodontists, and was one of the organizers of the Clinical Club of New Jersey. He also was one of the organizers of the American Dental Fraternity and was appointed to the State Board of Examination and Registration in Dentistry in 1919 by Governor Moore and served as President of the State Board in 1922.

Dr. Van Gieson belonged to several fraternal organizations, but his real hobby was golf at which pastime he became quite skillful. Dr. Van Gieson retired from active practice on account of ill health about two years previous to his death. He leaves his wife, Bessie Close Van Gieson, and a host of friends and confreres in the profession who mourn his loss.

News and Notes

American Association of Orthodontists

The Thirty-Eighth Annual Meeting of the American Association of Orthodontists will be held in Chicago, Ill., May 13 to 16, 1940, at the Edgewater Beach Hotel. All ethical members of the dental profession are invited.

CLAUDE R. WOOD, Secretary-Treasurer,
608 Medical Arts Building,
Knoxville, Tenn.

Southwestern Society of Orthodontists

The Nineteenth Annual Meeting of the Southwestern Society of Orthodontists will be held at the Rice Hotel, Houston, Texas, Feb. 18 to 21, 1940.

R. E. OLSON, Secretary-Treasurer
1001 Union Nat'l. Bank Bldg.
Wichita, Kan.

New York Society of Orthodontists

The spring meeting of the New York Society of Orthodontists will be held at the Waldorf-Astoria in New York City, March 11 and 12, 1940. Admission by invitation.

WILLIAM C. KELLER, Secretary-Treasurer
40 East 49th Street
New York, N. Y.

Chicago Association of Orthodontists

The Chicago Association of Orthodontists will meet March 25, 1940, at the Palmer House. Dr. Murray Hoffman and Dr. Morrie Massler of the Department of Histology, University of Illinois, will present a paper, "A Study of Bone Changes Incident to Eruption of Rat Molars."

A Problem for Orthodontists

The most recent matter to agitate the minds of orthodontists, particularly, throughout America is the diagnosis of Mortimer Snerd's malocclusion. The question arises as to whether it's a Class II, Division 1; Class I, Type 2; a maxillary protraction; a mandibular retraction; a combination of a little retraction and a little protraction; or just a plain case of buck teeth on a wooden apical base?

Northern Section Pacific Coast Society

The Northern Section of the Pacific Coast Society of Orthodontists met September 25, 1939, at the Washington Athletic Club, Seattle, Wash. Members present were Drs. Barker, Bishop, Chipman, Clark, Fisher, Fraser, Lewis, MacEwan, Mann, Meaney, and Moore.

The meeting was called to order by Chairman Bishop and the program rendered was as follows:

"Early Recognition and Correction of Abnormalities in the New Born Infant"—Dr. R. E. Ramaker.
"Closing an Orthodontic Practice"—Dr. M. R. Chipman.
"Tumors of the Jaw"—Dr. H. J. Wyckoff.
"Muscle Functioning and Its Aid in Orthodontic Treatment"—Dr. H. B. Robison.

Table Clinics—Drs. Bishop, Lewis, MacEwan, and Fisher.
"Ethics in Orthodontic Practice"—Dr. C. C. Mann.

Drs. Casey and MacEwan were elected Chairman and Secretary respectively for the ensuing year.

Central Section of the Pacific Coast Society

The September meeting of the Central Section of the Pacific Coast Society of Orthodontists was held on the twenty-third at the Alexander Hamilton Hotel in San Francisco, Dr. Wm. Walsh presiding.

Dr. Guy Hughes read a paper entitled "Socio-economic Aspects of Orthodontics." Dr. Hughes, among other things, stated that there was a challenge to the present day orthodontists to devise some means whereby more of the children needing orthodontic treatment could receive it, and that one disadvantage was that the present fees charged were beyond the circumstances of so many families.

The paper was followed by table clinics:

"Photography as an Aid to Diagnosis"—Dr. L. D. Russell.
"Threaded Chrome Alloy Arches"—Dr. Bernard Stark.
"Practical Method of Constructing Vernonite Retainers"—Dr. Richard Railsback.
"Use of Hawley Retainer as an Active Appliance"—Dr. Fred Epley.
"Soldering Brackets to Band Material"—Dr. Elgin Jackson.
"Simplicity of Treatment"—Dr. Ray Lussier.
"Explanation of X-rays to the Patients"—Dr. Seymour Gray.
"Sliding Hooks as Used in the Universal Appliance"—Dr. Jack McMath.

Southern Section Pacific Coast Society

The Southern Section of the Pacific Coast Society of Orthodontists was called to order at the University Club, Los Angeles, at 8:30 P.M. by Chairman Hays Nance.

Francis M. Pottenger, Jr., M.D., told of his research upon cats. He demonstrated malocclusion and dental disease in animals fed upon foods from which the heat labile factors had been destroyed.

This was followed by Professor Earf of Ohio State University who discussed the same problem as it affected the herbiverous animals.

The meeting was adjourned at 11:00 P.M.

Dr. A. Le Roy Johnson Receives Honorary Membership

One of the highlights of a very successful meeting of the Great Lakes Society held at Dearborn Inn, Nov. 6 and 7, 1939, was that of conferring honorary membership in that body upon Dr. Johnson. The following was the presentation by Ira A. Lehman, President.

"Now I have a duty to perform, and one that is a grand privilege. In fact it is the happiest duty that could be requested at this time. The Great Lakes Society has been, and should continue to be, very careful in the election of honorary members. In fact it has been so careful that after thirteen years of existence it still had no such member, and our first one has been elected today.

"As stated in the proposal to make this man an honorary member of this Society, he has been for a long time a thorough student and a wise teacher. In addition he has done outstanding work in the field of orthodontic research. This work considered the biologic problems of orthodontics and the causes of malocclusions. This phase of orthodontics has gained rapidly in prominence during the recent past, but he pioneered the field and has been considered an authority for over two decades.

"He has completely given his mind and heart to seek the causes of dental deformities in children and the soundest methods of treatment for their correction. The knowledge thus gained he has gladly disseminated to others.

"Dr. Johnson, you have been most generous in giving your time and energy to appear before this Society and in appreciation of all you have done, I am very happy to present to you the first honorary membership in the Great Lakes Society of Orthodontists."

Orthodontist Heads Study Club

The G. V. Black Study Club of Des Moines, Iowa, one of the outstanding dental organizations in Iowa, which was organized in 1907, has elected an orthodontist as their President. Dr. A. B. Thompson of Des Moines, Iowa, will pilot this organization for the year 1940.

Dr. Haverstick Honored

A testimonial dinner was given Dr. Edward E. Haverstick of St. Louis, Mo., in recognition of years of service as librarian and for the creation of the outstanding volume entitled, *The History of Dentistry in Missouri.*

Washington-Baltimore Society

The fall meeting of the Washington-Baltimore Society of Orthodontists was held at the Hay-Adams House in Washington, D. C., on the afternoon of Dec. 8, 1939.

Clinics were given by Lt. Col. William H. Siefert, U.S.A., Meyer Eggnatz of Baltimore, and George M. Anderson of Baltimore. A paper was presented by M. S. Aisenberg of Baltimore.

The meeting was concluded in the evening by an enjoyable dinner and good fellowship get-together.

Chicago Dental Society

The Chicago Dental Society will hold its 1940 midwinter meeting February 12 to 15, inclusive, at the Stevens Hotel, according to an announcement by Dr. Harold W. Welch, president.

Association of Dental Alumni Columbia University

February 12 is announced as Alumni Day for all graduates of C. D. O. S. and Columbia Dental School. The program will be held at the university at 116th Street and the central meeting at Alumni House.

Notes of Interest

Dr. O. W. Brandhorst announces the removal of his office to 4952 Maryland Avenue, St. Louis, Mo., for the continuance of the practice of orthodontics.

Dr. George Cowles Brown announces the association of Dr. Charles Johnson Goldthwaite with him in the continued exclusive practice of orthodontics, 332 Main Street, Worcester, Mass.

Dr. Theodore S. Martin announces the opening of an office suite at the new Medico-Dental Building, 1012 South Robertson Blvd. at Olympic, Los Angeles, Calif. Practice limited to orthodontics.

Dr. William Wedeen announces the removal of his office for the practice of orthodontics from Long Branch, N. J., to 63 E. Front Street, Red Bank, N. J.

Dr. H. G. Kushel announces the opening of his office for the exclusive practice of orthodontics in the Professional Building, 35 Chestnut Street, Rochester, N. Y.

Dr. Archie C. Gifford of Oshkosh, Wis., has been fortunate in having Dr. Gerald T. Milliette of Milwaukee care for his practice while he is recovering from a prolonged illness.

Dr. Eric H. Golden announces the removal of his office Dec. 1, 1939, to Suite 612-14 Wall Medical Building, St. Louis, Mo. Practice limited to orthodontics.

Dr. Thomas A. Gardner of Omaha, Neb., announces that his practice is now limited to orthodontics and that he has associated with him Dr. M. A. Spain, recently of Forsyth Dental Infirmary, whose practice is limited to pedodontia.

Dr. E. B. Pulliam announces that he is now associated with Dr. W. T. Pulliam at Corpus Christi, Texas. Practice limited to orthodontics.

OFFICERS OF ORTHODONTIC SOCIETIES*

American Association of Orthodontists

President, William A. Murray - - - - - - - - - - - - - - - - - - Evanston, Ill.
Secretary-Treasurer, Claude R. Wood - - - - - - - - - - - - - Knoxville, Tenn.
Public Relations Bureau Director, Dwight Anderson
- - - - - - - - - - - - - - - - - - 2 East 103rd St., New York, N. Y.

Central Association of Orthodontists

President, Max E. Ernst - - - - - - - - - - - - - - - - - - - St. Paul, Minn.
Secretary-Treasurer, L. B. Higley - - - - - - - - - - - - - - Iowa City, Iowa

Great Lakes Association of Orthodontists

President, Harvey G. Bean - - - - - - - - - - - - - - - - - - Toronto, Can.
Secretary-Treasurer, Richard E. Barnes - - - - - - - - - - - - Cleveland, Ohio

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President, I. D. Davis - Boston, Mass.
Secretary-Treasurer, Edward I. Silver - - - - - - - - - - - - Boston, Mass.

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President, Franklin A. Squires - - - - - - - - - - - - - - - White Plains, N. Y.
Secretary-Treasurer, William C. Keller - - - - - - - - - - - New York, N. Y.

Pacific Coast Society of Orthodontists

President, Will G. Sheffer - - - - - - - - - - - - - - - - - San Jose, Calif.
Secretary-Treasurer, Earl F. Lussier - - - - - - - - - - - - San Francisco, Calif.

Rocky Mountain Society of Orthodontists

President, Leonard T. Walsh - - - - - - - - - - - - - - - - - Pueblo, Colo.
Secretary-Treasurer, George Siersma - - - - - - - - - - - - - Denver, Colo.

Southern Society of Orthodontists

President, A. C. Broussard - - - - - - - - - - - - - - - - - New Orleans, La.
Secretary-Treasurer, T. C. Sparks - - - - - - - - - - - - - - Columbia, S. C.

Southwestern Society of Orthodontists

President, J. H. Weaver - - - - - - - - - - - - - - - - - - - Houston, Texas
Secretary-Treasurer, R. E. Olson - - - - - - - - - - - - - - - Wichita, Kan.

Washington-Baltimore Society of Orthodontists

President, B. E. Erikson - - - - - - - - - - - - - - - - - - Washington, D. C.
Secretary-Treasurer, Stephen C. Hopkins - - - - - - - - - - - Washington, D. C.

American Board of Orthodontics

President, Harry E. Kelsey - - - - - - - - - - - - - - - - - - Baltimore, Md.
Secretary, Charles R. Baker - - - - - - - - - - - - - - - - - - Evanston, Ill.
Treasurer, Bernard G. DeVries - - - - - - - - - - - - - - - - Minneapolis, Minn.
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Frederic T. Murlless, Jr. - - - - - - - - - - - - - - - - - Hartford, Conn.
Oliver W. White - Detroit, Mich.
James D. McCoy - Los Angeles, Calif.

Foreign Societies†

British Society for the Study of Orthodontics

President, S. A. Riddett
Secretary, R. Cutler
Treasurer, H. R. Evans

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*The Journal will make changes or additions to the above list when notified by the secretary-treasurer of the various societies. In the event societies desire more complete publication of the names of officers, this will be done upon receipt of the names from the secretary-treasurer.

†The Journal will publish the names of the president and secretary-treasurer of foreign orthodontic societies if the information is sent direct to the editor, 8022 Forsythe, St. Louis, Mo., U. S. A.